

Technical Session

Vehicle Rollover Stability and Rollover Crash Protection

Oral Presentations
Tuesday, May 20, 2003
09:00 - 12:30

Chairperson: Riley Garrott, United States

Room: Track A: Hall 1

Paper No.222-O

A methodology for estimating vehicle rollover propensity

Shane Richardson, Raphael Grzebieta
Monash University Department of Civil Engineering
George Rechnitzer - Monash University
Accident Research Centre
Australia

Abstract

This paper proposes a methodology that allows the combination of the Stability Factor and handling characteristic to predict the probability of rollover per single vehicle crash.

Paper No.202-O

Simulation of Occupant Kinematics in Vehicle Rollover - Dummy Model versus Human Model

Norbert Praxl, Markus Schönpflug, Jiri Adamec
Institute for Legal Medicine
Munich, Germany

Abstract

Currently, 25% of all automobile crashes with severe injuries are rollover crashes and the incidence of this particular accident type even shows an upward tendency (e.g. Minivans, MPVs). Therefore, there is a great potential of injury reduction in that area. Available dummies are designed and validated for impacts but not for complex kinematics. Existing human models with flexible spine and realistic joints should provide a better biofidelity than dummies. Therefore the main objective of the investigation is to compare dummy and human model in standard rollover crashes.

Paper No.231-O

Crash Attributes that Influence the Severity of Rollover Crashes

Kennerly Digges, Ana Maria Eigen
National Crash Analysis Center,
The George Washington University
United States

Abstract

This analysis examines restrained and unrestrained occupants in crashes with and without ejections. It investigates cars, pickups, vans and SUV's as separate classes. The relative severity of single vehicle vs. multi vehicle rollover crash events is examined. Other crash severity variables evaluated include the number of quarter turns, the number of roof contacts, and the extent of vehicle damage.

Paper No.236-O

MADYMO Modeling Method of Rollover Event and Occupant Behavior in Each Rollover Initiation Type

Hideo Takagi, Akihisa Maruyama
Nissan Motor Co., Ltd.
Koichi Kawaguchi TNO-Automotive
Japan
Jeff Dix, Nissan Technical Center
North America Inc.
United States

Abstract

There are many initiation events that can cause a vehicle rollover, and the occupant behavior is different for each type of rollover initiation. Therefore it is necessary to understand the differences in occupant behavior for each type of rollover. This paper describes a MADYMO modeling method used to study occupant kinematics in various rollover events that was developed using vehicle rollover research test data.

Paper No.254-O

Vehicle rollover - An important element in multiple impact crashes

Paul Fay, Ford Motor Company
Richard Frampton, Vehicle Safety Research
Centre, Loughborough University
United Kingdom
Raimondo Sferco, Automotive Safety Office,
Ford Motor Company
Germany

Abstract

This paper describes a detailed analysis of multiple impact crashes which involve rollover and considers:

- the impact events leading up to the rollover
- the resulting rollover and
- the injury sustained.

This analysis highlights a number of issues, which have implications for:

- the sensing of rollover events
- the position of occupants at the start of the rollover event
- potential countermeasures and
- the deployment of rollover protection devices.

Paper No.288-O

Multibody Analysis Of M3 Bus Rollover: Structural Behaviour and Passenger Injury Risk

Paolo Martella, Giovanni Belingardi,
Lorenzo Peroni, Davide Gastaldin
Politecnico di Torino, Italy

Abstract

In this work the MB approach has been used to study the structural behaviour of an M3 bus in a rollover scenario, to evaluate the structure resistance and passenger injuries. This research is part of the ECBOS project (Enhanced Coach and Bus Occupant Safety), granted by the European Union.

Paper No.321-O

Rollover Resistance Test Procedure Involving Maximum Roll Momentum

Brian Kebschull, Dynamic Research, Inc.
Marc Ernst, Honda R&D Americas, Inc.
United States
Keisuke Ishii, Honda R&D Co., Ltd.
Japan

Abstract

A procedure that was developed by Honda R&D to measure and evaluate vehicle rollover resistance is described. This procedure incorporates the use of an automatic vehicle controller to provide precise and repeatable "Fishhook" type steering inputs. A distinguishing feature of this procedure is the roll rate feedback algorithm used to determine when the steering reversal is to occur.

Paper No.342-O

Status of NHTSA's Ejection Mitigation Research Program

Donald Willke, Stephen Summers
National Highway Traffic Safety Administration
J. Stephen Duffy, Allison E.Louden, Jeffrey C.Elias
Transportation Research Center, Inc.
United States

Abstract

A dynamic rollover fixture (DRF) was developed as a research tool to produce full-dummy ejections more repeatably and less costly than full-scale testing. The DRF is being used to evaluate the effectiveness of inflatable devices, advanced glazings, and combinations of these systems in reducing occupant ejections. Also, impactor tests were previously developed to measure the retention and head injury causing potential of advanced glazing systems. These tests are being examined to determine if they are suitable for evaluating inflatable devices and combination systems. This paper will discuss the status of the agency's current ejection mitigation research program.

Paper No.383-O

Safety Systems To Reduce The Rollover Risk Of Vehicles

Helmut Fennel
Continental Teves
Germany

Abstract

The paper focuses on modern active and passive Safety Control Systems that are able to avoid critical rollover situations and to protect the occupants of the vehicle.

Paper No.436-O

The Importance of Dynamic Testing in Determining the Yaw Stability of Vehicles

Don Stevens, Stephen Arndt
Safety Engineering and Forensic Analysis, Inc.
Mark Arndt, Transportation Safety Technologies, Inc.
L. Daniel Metz, Metz Engineering and Racing
United States

Abstract

To reduce the likelihood of rollover, the yaw stability of a vehicle must be evaluated through full-scale testing. Quasi-static testing alone is insufficient to establish the yaw stability of a vehicle; full-scale transient testing is also necessary. Handling tests were conducted on a 15-passenger van demonstrating substantial differences in vehicle performance between circle turn tests and j-turn tests.

Paper No.444-O

Heavy trucks rollover simulation

Yves Delanne, Laboratoire Central des Ponts
et Chaussées (LCPC)
Vincent Schmitt, Etablissement Technique
d'Angers (ETAS)
France

Abstract

This paper is concerned with truck rollover simulation and more precisely with the validation of a vehicle dynamics simulation package called PROSPER by the comparison of ground test and computation results.

Paper No.488-O

An Overview of NHTSA's Recent Light Vehicle Dynamic Rollover Propensity Research and Consumer Information Program

Garrick Forkenbrock, W. Riley Garrott, Patrick Boyd
US Department of Transportation
National Highway Traffic Safety Administration
United States

Abstract

This paper contains a brief assessment of eight rollover resistance maneuvers and discusses how rollover risk may be conveyed to the public via a consumer information program. A discussion of how ambient temperature, surface variability, and outriggers design can affect test.

Paper No.548-O

Development of Rollover Curtain Shield Airbag System

Hiroyuki Takahashi, Motomi Iyoda, Masami Aga,
Makoto Sekizuka, Youichi Kozuru, Shuichi Ishimoto
Toyota Motor Corporation
Japan

Abstract

SUV rollover crashes are a significant safety problem especially in the U.S. because this type of vehicle is involved in rollover-related occupant fatalities more often than other vehicle types.

Technical Session

*Compatibility in Frontal/Side Collisions

Oral Presentations
Tuesday, May 20, 2003
09:00 - 12:30

Chairperson: Peter O'Reilly, United Kingdom

Room: Track B: Hall 2

Paper No.402-O

Status Report of IHRA Compatibility and Frontal Impact Working Group

Peter O'Reilly
Department for Transport
United Kingdom

Abstract

The IHRA Compatibility and Frontal Impact Working Group report overviews the thrust of work to date on compatibility including the current position on potential test procedures.

Paper No.113-O

Research on Vehicle Compatibility in Japan

Koji Mizuni
National Traffic Safety and Environmental
Research Laboratory
Kazumasa Tateishi, Yuji Arai
Japan Automobile Research Institute
Toshiyuki Nishimoto
Ministry of Land, Infrastructure and Transport
Japan

Abstract

This paper focuses on research conducted in Japan regarding the evaluation of vehicle compatibility. Car-to-car crash tests were performed, and the key points to ensure compatibility were investigated. Based on a test series including full frontal, ODB and overload, the criteria to evaluate compatibility were examined. Structural homogeneity was also examined based on JNCAP full frontal tests.

Paper No.307-O

NHTSA's Research Program for Vehicle Compatibility

Stephen Summers, William Hollowell,
Aloke Prasad
National Highway Traffic
Safety Administration
United States

Abstract

This paper presents an overview of NHTSA's vehicle compatibility research activities.

Paper No.346-O

EEVC Research in the Field of Improvement of Crash Compatibility Between Passenger Cars

Eberhard Faerber
Federal Highway Research Institute
Germany

Abstract

At the 2001 ESV-Conference the EEVC working group on compatibility (WG 15) has reported the first phase of the attempt to investigate compatibility between passenger cars. After the 2001 ESV-Conference the EEVC working group on compatibility prepared the next phase of research in the field of compatibility. In the next phase a procedure shall be developed to assess the compatibility of passenger cars in frontal impacts. In this paper the preparatory work which was partly subventioned by the European Commission will be reported.

Paper No.274-O

Australian Research to Support the IHRA Vehicle Compatibility Working Group

Keith Seyer, Craig Newland,
Mark Terrell, Department of Transport and
Regional Services
Australia

Abstract

This paper details the research conducted by the Australian Department of Transport and Regional Services to examine a proposal for a compatibility test procedure. All data has been fed into the deliberations of the IHRA Vehicle Compatibility Working Group. The research has been done in partnership with the US National Highway Traffic Safety Administration, Subaru, Ford and Renault.

Paper No.86-O

Development of Test Procedures and Performance Criteria to Improve Compatibility in Car Frontal Collisions

Mervyn Edwards, Huw Davies, Adrian Hobbs
TRL Limited (Transport Research Laboratory)
United Kingdom

Abstract

This paper outlines the present understanding of compatibility for frontal collisions and reports the current state of development of three possible test procedures to address the fundamental issues, namely: structural interaction, frontal stiffness matching and passenger compartment strength. The development of a new deformable barrier face and performance criteria for the structural interaction test are described.

Paper No.287-O

Improvement of Compatibility of Passenger Vehicles - Next feasible steps

Thomas Schwarz, Robert Zobel
Volkswagen AG
Germany

Abstract

The paper will summarize research results of European Automotive Industry with regard to compatibility. It will analyse different compatibility evaluation test procedures and provide a basis for short-term and long-term steps.

Paper No.437-O

A Study of Compatibility Test Procedures in Frontal Impact

Satoshi Takizawa, Tomiji Sugimoto,
Hideki Suzuki, Honda R&D
Japan

Abstract

The purpose of this study is to examine compatibility test procedures proposed in the IHRA Vehicle Compatibility Working Group. 1) A full width Load Cell Barrier test in which the load cell data was analyzed to evaluate structural interaction of vehicles. 2) MDB-to-vehicle tests were conducted to confirm the reproducibility of vehicle-to-vehicle tests; the test results and analysis are reported in this paper.

Paper No.94-O

New front structural design to improve compatibility

Pascal Delannoy
Teuchos Group - Renault Safety
Department
Jacques Faure
Renault. SA, France

Abstract

This paper describes the different relevant factors for each safety and reparability requirement, proposes technical improvements among them in terms of front structural aspects which are really going to improve compatibility.

Paper No.454-O

Compatibility for frontal impact collisions between heavy and light cars

Shigeru Hirayama, Kazuhiro Obayashi,
Tomosaburo Okabe
Nissan Motor Co., Ltd.
Japan

Abstract

This paper outlines our recent study regarding compatibility for frontal impact collisions between cars that have the different vehicle weight and reports verification on efficacy of some proposed new test procedures from the viewpoint to improve compatibility of cars in these classes.

Paper No.412-O

Perspectives on Vehicle Crash Compatibility and Relationship to Other Safety Criteria

Mukul Verma, Joseph Lavelle, Robert Lange
General Motors, United States

Abstract

This paper investigates - (i) the relationship between injury levels in vehicle to vehicle crashes and the measured deformations, (ii) the influence of front crash test procedures on front stiffness and collision compatibility of vehicles, and (iii) the effect of design for side impact protection on vehicle.

Paper No.445-O

Numerical fleet optimization studies for improved compatibility

Paul Lemmen, Cor van der Zweep,
Floris Leneman, TNO Automotive
Paul Altamore, TNO-MADYMO
North America, United States

Abstract

On behalf of NHTSA and the Dutch Ministry of Traffic and Transport the Safety department of TNO Automotive is performing numerical fleet studies using multi-body models. Aim is to develop strategies for optimization of front-end structures minimizing the total harm in car-to-car crashes on a fleet-wide basis. This paper gives results of a study on offset frontal impacts, presenting the optimization strategy for stiffness and geometry variations. To make fleet-wide optimizations successful it was found to be necessary to first identify relevant design parameters and crash scenarios from parametric studies. Using these relevant parameters it was found to be possible to reduce the overall harm in a vehicle fleet.

Paper No.117-O

Combining The Finite Element Models Of The Ford Falcon And Subaru Legacy To Improve Vehicle Compatibility

Ming Loo
Ford Motor Company of Australia Ltd
Tim Stinton, Bruce Priddle
Ford Motor Company
Keith Seyer
Department of Transport and
Regional Services, Australia

Abstract

This paper firstly describes how the finite element models of the Ford BA Falcon and the Subaru Legacy were combined so that a parametric study varying design features of each vehicle could be conducted to determine their effect on compatibility. The paper then reports on how the compatibility of the two vehicles in an offset frontal crash is affected by changing a number of design features.

Paper No.239-O

Innovative body structure for the self-protection of a small car in a frontal vehicle-to- vehicle crash

Masuhiko Saito, Tetsuya Gomi, Yoshinori Taguchi,
Takeshi Yoshimoto, Tomiji Sugimoto
Honda R&D Co., Ltd, Tochigi R&D Center
Japan

Abstract

The proposed innovative body structure in the front of a small car could accomplish highly efficient energy absorption which has never been done previously and maintain the cabin integrity.

Technical Session

NCAP Related To Existing Test Procedures

Oral Presentations
Tuesday, May 20, 2003
09:00 - 12:30

Chairperson: Keith Rodgers, United Kingdom

Room: Track C: Room 431 & 432

Paper No.244-O

What we learned from JNCAP and our proposals

Yuji Ono, National Organization for
Automotive Safety & Victims' Aid
Yuji Kimura, Ministry of Land,
Infrastructure and Transport
Koji Mizuno, National Traffic Safety and
Environment Laboratory, Japan

Abstract

The paper provides a brief profile of the JNCAP (Japan New Car Assessment Program). The JNCAP presently conducts brake, full and offset frontal impact, side impact and child seat safety performance tests. The overall evaluation of three crash tests after 2000 has resulted in significant improvements in crashworthiness. Pedestrian protection performance as well as pole impact tests are under study for introduction.

Paper No. 65-O

Impacts of Recent Korean NCAP Programs in Automotive Safety

Younghan Youn
Korea University of Technology
and Education
Gyuhyun Kim, Geejoong Yong
Korea Automotive Testing and
Research Institution
Insik Kwon
Ministry of Construction and
Transportation, Republic of Korea

Abstract

From 1999, Korean government established the Korean New Car Assessment Program. Since small numbers of new

vehicles were introduced in the market each year at the beginning year, KNCAP committee decided to selection of testing vehicle with same class vehicle, tested and compared. The test results directly impacted to the market both consumers and manufacturers due to the same class test comparisons.

Paper No.469-O

Australian NCAP Future Strategy

Lauchlan McIntosh
Australian NCAP, Australia

Abstract

In Australia vehicle safety improvements are necessary to continue the downward trend in injury reduction. A strategic review was carried out in 2002 to determine a further ten year vision for the program using current and projected market data, funding and the benefits of harmonised testing. From this ANCAP has identified new performance assessments that will ensure a continued focus on injury reduction.

Paper No.470-O

ANCAP Future Technical Directions

Christopher Coxon,
Australian NCAP
Australia

Abstract

ANCAP has reviewed international crash test programs to identify occupant safety information within its available budget. Using harmonised crash tests remains a key focus to allow access to data from other NCAP tests. Adding pre-crash information to ANCAP assessments is suggested but presenting the information in a simple format is a challenge.

Paper No.120-O

Proposition of a method to evaluate active safety handling qualities

Eric Fenaux
PSA Peugeot Citroen
France, Metropolitan

Abstract

A method to choose tests related to real accidents and a way to derive metrics is described.

Paper No.351-O

Crash Testing For Real-World Safety – What Are The Priorities For Casualty Reduction?

Pete Thomas, Richard Frampton
Vehicle Safety Research Centre
United Kingdom

Abstract

UK CCIS crash injury data is analysed to assess EuroNCAP test procedures. Large observed reductions in head injuries are not matched by reductions in injuries to other body regions including the chest and legs. Deficiencies are found with vehicle compatibility with roadside obstacles. Priority areas also include side impact protection at higher collision severities and the protection of non-struck side occupants.

Paper No.192-O

A review of 'B'-pillar and front seat belt loads measured in ANCAP offset frontal crash tests.

James Hurnall
Australian Automobile Association
Angus Draheim
Queensland Department of Transport
Michael Case, Julian Del Beato
Royal Automobile Club of Victoria
Australia

Abstract

ANCAP have been conducting offset frontal crash tests since 1995. The analysis conducted shows that while there has been significant improvements in occupant protection there has not been significant changes in B-pillar and front seat belt loads of the vehicles tested.

Paper No.527-O

Evaluation of Vehicle Stiffness Measures from the U.S. New Car Assessment Program

Jesse Swanson, Taryn Rockwell,
Nathaniel Beuse, Brian Park, Stephen Summers,
Lori Summers, National Highway Traffic
Safety Administration
United States

Abstract

This paper examines both traditional and innovative stiffness metrics to gain insight into the usefulness of these measures and how NCAP testing may influence vehicle design.

Technical Session

Real World Data Acquisition, Injury Risk Assessment and Functional Capacity Metrics

Oral Presentations
Tuesday, May 20, 2003
14:00-17:30

Chairperson: Koshiro Ono, Japan

Room: Track A: Hall 1

Paper No.102-O

Effect of Vehicle and Crash Factors on Older Occupant Injury

Rory A. Austin, Barbara M. Faigin
National Highway Traffic
Safety Administration
United States

Abstract

The substantial projected increase in the number of United States residents aged 65 years old or older is important because older occupants are over represented in crashes involving serious injuries or fatalities. This paper demonstrates that vehicle and crash characteristics explain injury rates across age groups and provides information regarding crashworthiness issues that are significant for older occupants.

Paper No.161-O

Scientific Approach and Methodology of a New In-depth Investigation Study in Germany so called GIDAS

Dietmar Otte
Accident Research Unit Medical
Christian Krettek
Medical University Hannover
Horst Brunner, Hans Zwipp
Technical University Dresden
Germany

Abstract

The paper is describing the methodology of an in-depth-investigation project called GIDAS, carried out in Germany at 2

location Hannover and Dresden by order of the German government BAST in a joint cooperation with the automobile industry FAT. Annually 2000 cases of all kind of traffic accidents with injury outcomes are documented by a statistical random plan.

Paper No.175-O

SARAC - Safety Rating Based on Real-World Crashes for Supplementation of New Car Assessment Programs

Klaus Langwieder
Comité Européen des Assurances
(CEA), German Insurance
Association (GDV), Germany
Brian Fildes, MaxCameron
Monash University Accident
Research Center, Australia
Timo Ernvall, Helsinki University of Technology
Transportation Engineering, Finland

Abstract

The project "Quality Criteria for the Safety Assessment of Cars based on Real World Crashes" was successfully terminated by end of 2001. The main results and an outlook over the 2nd project phase will be presented. Future investigations will include in-depth comparison of existing rating methods, consideration of active safety systems, possibilities of analysing the injury outcome in car/pedestrian crashes in this respect and the establishment of a database containing real-world crash data of vehicle models tested also in NCAPs.

Paper No.233-O

Essential Components of a Statistically Valid Crashworthiness Rating

Jens -Peter Kreiss
Technical University of Braunschweig
Sebastian Busch, Robert Zobel
Accident Research, Volkswagen AG
Germany

Abstract

This paper reports on a SARAC project, which intends to establish a crashworthiness rating, which takes fuller account of the ordinary injury scales usually available in large databases. We discuss existing rating methods and investigate, whether essential assumptions of these proposals can be justified from accident data. On this basis we present possibilities to further improve these ratings.

Paper No.348-O

Moped and mofa accidents in the Netherlands from 1999-2001: accident and injury causation

Ydo de Vries, Dimitri Margaritis,
Herman Mooi
TNO Automotive, Netherlands

Abstract

In this paper moped and mofa accidents from 1999 – 2001 in the Netherlands are analysed. An internationally harmonised method for the investigation of motorised two-wheelers was used. For this study a total of 114 moped and 21 mofa accidents are analysed. Data are analysed statistically to find the over and under represented factors. Recommendations are given for primary and secondary safety.

Paper No.361-O

Pan-European Co-ordinated Accident and Injury Databases

Andrew Morris, Pete Thomas
Vehicle Safety Research Centre
United Kingdom

Abstract

This paper describes the methodology and purposes of a new initiative for co-ordinated accident studies within Europe. The expected end result of this study will be a co-ordinated system to inform European vehicle safety policy in a systematic integrated manner. Furthermore, the results of data analyses will provide new directions to develop injury countermeasures and safety regulations.

Paper No.404-O

Combining Crash Recorder and Paired Comparisons Technique: Injury Risk Functions in Frontal and Rear-end Impacts with Special Reference to Neck Injuries

Anders Kullgren, Maria Krafft
Folksam Research
Anders Lie
Swedish National Road Administration
Claes Tingvall
Swedish National Road Administration
and Monash University Accident
Research Centre, Sweden

Abstract

By combining statistical material with in depth crash recorder data, injury risk functions for injuries to different body regions and for AIS1 neck injuries in both frontal and rear-end impacts were established. It was found that risk functions based on crash pulse recorders could be used to validate and calibrate risk functions based on the matched-paired technique.

Paper No.409-O

Applications of the Crash Injury Research and Engineering Network (CIREN) Database

Catherine McCullough
National Highway Traffic
Safety Administration
Jingfei Wu
Volpe National Transportation
Systems Center, United States

Abstract

The Crash Injury Research and Engineering Network (CIREN) is a multi-center collaborative research program that focuses on in-depth studies of serious motor vehicle crashes. This paper will examine the data available and show how it can be used to correlate injury patterns with crash types.

Paper No.416-O

An Overview of Knee-Thigh-Hip Injuries in Automobile Crashes in the United States

Shashi Kuppa
National Highway Traffic
Safety Administration
Osvaldo Fessehaie
Information Systems &
Services, Inc., United States

Abstract

This paper examines the influence of crash mode, restraint status, occupant gender and anthropometry, and vehicle size and model year on the frequency and risk of knee-thigh-hip injuries and their associated loss in quality of life and societal cost.

Paper No.422-O

Fire Safety Performance of Motor Vehicles in Crashes

Kennerly H. Digges, R. Rhoads Stephenson
Motor Vehicle Fire Research Institute
Paul Bedewi
FHWA/NHTSA National Crash
Analysis Center, The George
Washington University, United States

Abstract

This paper documents five current research programs on fire safety technology. These programs involve analysis of field data, and testing. The test program includes fire and impact testing of fuel tanks and testing of electrical arcing ignition sources. The summary results of the data analysis projects will be reported in detail.

Paper No.490-O

Estimating Crash Severity: Can Event Data Recorders Replace Accident Reconstruction?

Hampton Gabler, Carolyn Hampton
Rowan University
Thomas Roston U.S. National Highway
Traffic Safety Administration
United States

Abstract

The Event Data Recorders (EDRs), now being installed as standard equipment by several automakers, have the potential to provide an independent measurement of crash severity which avoids many of the difficulties of accident reconstruction techniques. This paper evaluates the feasibility and technical limitations of replacing delta-V estimates from accident reconstruction with the delta-V computed from EDRs.

Distinctive Feature of Traffic Accidents and In-depth Investigation In Japan

Miyake Tetsushi
Institute for Traffic Accident Research
and Data Analysis, Japan

Abstract

(1) Distinctive feature of the traffic accidents in Japan (increase of automobile occupant fatalities, especially, increase of aged fatalities). (2) Activity of ITARDA (analysis of the integrated accident database, ITARDA Information) (3) Distinctive feature of the In-depth Investigation in Japan (human factors, human errors) (4) Distinctive feature of the aged drivers' accidents and injury severity.

Paper No.496-O

Technical Session

Advanced Technology #1: Passive Restraint Systems

Oral Presentations
Tuesday, May 20, 2003
14:00-17:30

Chairperson: Anders Lie, Sweden

Room: Track B: Hall 2

Paper No.414-O

The Performance of Advanced Airbag-equipped Vehicles in Frontal Crashes

Matthew Maltese, Alope Prasad,
Nathaniel Beuse, William T. Hollowell
National Highway Traffic
Safety Administration
United States

Abstract

A series of frontal rigid barrier crash tests were conducted to evaluate the performance of advanced air bags in mitigating injury in the 5th female population exposed to low speed crashes, and the 50th male exposed to high speed crashes.

Paper No.206-O

Development of occupant classification system

Tsutomu Takano
Nissan Motor Co., LTD
Japan

Abstract

Nissan develops Occupant Classification System (ODS) for Advanced Airbag requirements of FMVSS208. This paper describes detection mechanisms and system performance. This system satisfies requirements.

Paper No.480-O

Research of an advanced seat belt system

Koichi Kamiji, Hiroshi Akaba
Honda R&D, Japan

Abstract

The progress of the occupant restraint device in crash safety is remarkable in recent years. In other hand the crash avoidance technology has also accomplished rapid evolution. Various proposals about the next-generation occupant restraint technology with which each was united in those technologies are made. This paper considers the effect and subject about research of a next-generation seat belt system as the first step.

Paper No.189-O

Development of Pre-Crash Active Seatbelt System

Hideo Tobata, Hideo Takagi, Chinmoy Pal,
Shunichi Fukuda
Nissan Motor Co., LTD.
Japan

Abstract

This paper illustrates a pre-crash reversible active seatbelt system. This system removes the slack in the seatbelt at first and finally hold the occupant firmly against the seat in pre-crash phase. After the emergency situation is avoided, seatbelt tension is released. The effectiveness and benefits of this system was verified through experiments and numerical simulations.

Paper No.314-O

Continuously Predicting Crash Severity

Dorel Sala, J.T. Wang
General Motors Corporation
United States

Abstract

In this paper we describe a frontal impact crash sensing algorithm capable of continuously predicting the severity of a crash in real time. This algorithm could be used to control an airbag system with a variable output inflator.

Paper No.198-O

The effect of occupant protection by controlling airbag and seatbelt

Teru Iyota, Toshihiro Ishikawa
Mazda Motor Corporation
Japan

Abstract

Recently, it has been reported that greater proportion of heavier male occupants and lighter female occupants sustain serious injuries in frontal crash. In this study, controlling the vent hole size of the airbag and the load limiter force of the seatbelt, the effect of occupant protection for different occupant size was evaluated by using MADYMO.

Paper No.481-O

Fundamental Relation between Firetime and Impact Severity Estimation Uncertainty

Guglielmo Rabbiolo, Laura Di Domenico,
Guy Nusholtz, DaimlerChrysler
United States

Abstract

This paper presents a relationship between the amount of time needed for the airbag sensor to estimate the severity of impacts and the uncertainty of that estimation. Examples based on actual crash data are presented to illustrate the theoretical work.

Paper No.406-O

Reducing Highway Deaths and Disabilities with Automatic Wireless Transmission of Serious Injury Probability Ratings from Vehicles in Crashes to EMS

Howard Champion, Uniformed Services
University of the Health Sciences
Jeffrey Augenstein, University of Miami
Alan Blatt, Veridian
Brad Cushing, Maine Medical Center
Kennerly Digges, George Washington University
Richard Hunt, State University of New York,
Upstate Medical University
Louis Lombardo, National Highway
Traffic Safety Administration
John Siegel, University of Medicine and
Dentistry of New Jersey, United States

Abstract

The National Highway Traffic Safety Administration (NHTSA) developed software called URGENCY for use with Automatic Crash Notification (ACN) technologies to improve triage, transport, and treatment decision-making. The aim is to identify, instantly and automatically, the approximately 250,000 crashed vehicles with serious injuries occurring each year from the 28,000,000 crashed vehicles with minor or no injuries.

Paper No.512-O

Two-Impact Crashes - Implications for Occupant Protection Technologies

James Lenard, Richard Frampton
Vehicle Safety Research Centre
United Kingdom

Abstract

Recent advances in intelligent primary and secondary safety technologies make it feasible to design vehicles for multiple impacts. This paper presents an analysis of impacts to twice-struck passenger cars, drawn from an in-depth sample of thousands of accidents, including when injury occurred. The results indicate the scope for potential benefits and the impact sequences that should receive design priority.

Paper No.451-O

Benefits of a 3+2 point belt and an inboard torso side support in frontal, far side and rollover crashes

Ola Bostrom, Yngve Haland
Autoliv Research, Sweden

Abstract

In this study an extra supplementary 2-point belt (also one-hand buckled up) combined with an inboard torso side support is suggested to offer benefits in real life crashes. The idea is simply to distribute the belt load on more anatomical structures (bones) as well as constituting a non-injurious inboard and upward restraint.

Paper No.547-O

Achieving design target through stochastic impact simulations

Tsuyoshi Yasuki, Masaaki Okamoto,
Atsushi Okamoto, Toyota Motor Corporation
Japan

Abstract

Crash analysis is not only a tool for confirming a design direction, but also becoming a tool for evaluating vehicle performance. Crash performance has reproductability and repeatability and these phenomena should be taken account if the crash analysis was applied to evaluation of crash.

Paper No.248-O

Performance of Seating Systems in FMVSS No. 301 Rear Crash Tests

James Saunders III, Louis Molino,
Shashi Kuppa, Felicia Mckoy
National Highway Traffic safety
United States

Abstract

NHTSA has determined that improving seating system performance may be more complex than simply increasing the strength of the seat. Therefore, NHTSA is investigating the use FMVSS 301 rear crash tests procedure as a way to assess occupant protection in moderate to high-speed rear impacts. This paper summarizes the results of these vehicle crash tests.

Technical Session

***Biomechanics #1: Injury Criteria and Dummy Development**

Oral Presentations
Tuesday, May 20, 2003
14:00 - 17:30

Chairperson: Rolf Eppinger, United States
Room: Track C: Room 431 & 432

Paper 578-O
International Harmonized Research Activities (IHRA)
Status Report Of The Biomechanics Working Group

Rolf H. Eppinger
National Highway Traffic
Safety Administration
United States

Abstract

A summary of the continued efforts of the Biomechanics Working Group to complete its original task given to it by the International Harmonized Research Activities Steering Committee, determining specifications for a Universal Side Impact Anthropomorphic Test Devices, is presented, as is a discussion of new Terms of Reference the working group proposed to the IHRA Steering Committee.

Paper No. 125-O
The Upper-Body Response of Thor in Frontal Barrier Tests

Douglas Longhitano, John Turley
Honda R&D Americas, Inc.
United States

Abstract

In this study we conducted five crash tests in order to assess THOR's performance relative to the Hybrid III. The full THOR, Hybrid III with THOR-Lx, and standard Hybrid III ATD configurations were used in the flat rigid barrier and offset deformable barrier test modes. Comparison of the data from these tests shows similar values for head injury and chest acceleration, but the data traces have different profiles.

Paper No.421-O
Design Requirements for a Fifth Percentile Female Version of the THOR ATD

T. Shams, T.J. Huang,
N. Rangarajan, GESAC, Inc.
M. Haffner, National Highway
Traffic Safety Administration
United States

Abstract

Requirements have been developed and are presented for the design of a fifth percentile female version of the NHTSA THOR male dummy. These include the necessary anthropometric requirements developed by Schneider [1983] and appropriate scaling of dynamic responses of the 50th percentile male THOR frontal crash dummy.

Paper No.354-O
Response characteristic of various side impact dummies

Masaomi Goto, Takahiko Uchimura,
Kazumi Hisajima
Nissan Motor Co., Ltd, Japan

Abstract

Different side impact dummies and procedures are currently used for the US and Europe/Japan. To harmonize the side impact dummy, World SID development was initiated under ISO in 1997. Also, ES2 an improved version of Eurosid-1, was introduced after the introduction of the small side impact dummy, SID-IIs.

Paper No.388-O

Updated Biofidelity Rating of the Revised World SID Prototype Dummy

Edmund Hautmann, BMW Group
Klaus Bortenschlager, Germany Audi
Germany

Risa Scherer, Ford
Akihiko Akiyama, Honda

Minoru Sakurai, Takeshi Harigae
JARI, Japan

Martin Page, CEESAR, France

Greg Kostyniuk, Lan Xu

DaimlerChrysler, United States
Suzanne Tylko, Transport Canada, Canada

Abstract

The World SID has been developed within an international project. The biofidelity of the first prototype was evaluated resulting in some suggestions for further refinements. An updated version was developed and submitted to another series of evaluation tests. This paper presents the design modifications implemented in the revised prototype and its performance during the second round of biofidelity testing.

Paper No.398-O

Lumped Spring-Mass Model of ES-2 dummy and Parametric Evaluation of Design Variables to Improve Side Impact Performance

MurthyKowsika, Yibing Shi,
Guy Nusholtz, DaimlerChrysler
United States

Abstract

A lumped spring-mass model of the ES-2 dummy is derived from sled test data using system identification techniques. Model validation studies are conducted under various loading conditions and the simulated dynamic response correlated well with the experimental data. Using this model, parametric studies are conducted to characterize the influence of impact velocity, pelvis offset, padding thickness and padding force-deformation behavior on the dummy response. Design conditions that resulted in improving the ES-2 dummy response are highlighted.

Paper No.195-O

A Study of Whiplash Injury Occurrence Mechanism Using Human Finite Element Model

Junji Hasegawa
Toyota Motor Corporation
Japan

Abstract

Approximately 20% of car-to- car accidents in the U.S. are believed to be rear-end collisions, and approximately 10% of the whiplash injuries resulting from rear-end impacts require longer term therapy. Thus, the societal cost of whiplash injuries is a common problem worldwide, so its prevention is a hot topic globally.

Paper No.203-O

Developing a new seat systems to reduce whiplash injuries by K-D neck model (a new biomechanical cervical model)

Masatoshi Tanaka, Daihatsu Motor Co., Ltd
Hiroaki Yoshida, Sadami Tsutsumi
Kyoto University Institute for Frontier
Medical Sciences, Japan

Abstract

To reproduce human neck movements at low-speed rear-end collisions, we made anatomical experiments using a new biomechanical cervical model named as " K-D neck model" and FEM analyses including active and passive muscle elements. Sled tests reproduced shear displacements of the intervertebral disks of passengers not aware of rear-end collisions and the new seat system reducing whiplash injuries was developed.

Paper No.208-O

Development of a Finite Element Model of the Human Neck for Whiplash Simulation

Seiichi Kobayashi, Yuichi Kitagawa
Nissan Motor Co., Ltd.
Japan

Abstract

A finite element model of the human neck complex has been developed in this study. The model consists of the vertebral bodies, internal discs, ligaments and muscles. The model was first validated against volunteer tests by examining the head responses and kinematics under induced motion given to the torso. Then the whole upper body motion was simulated by including the entire spine and the seat system.

Paper No.344-O

Validation of Neck Injury Criteria Using Reconstructed Real-Life Rear-end Crashes with Recorded Crash Pulses

Anders Kullgren, Maria Krafft , Folksam Research
Linda Eriksson, Autoliv Sweden and Chalmers
University of Technology
Ola Boström, Autoliv Research, Sweden

Abstract

Neck injury criteria was validated by correlating results from real-life crashes with recorded crash pulses with simulated dummy readings using Madymo models with a BioRID II dummy. It was found that NIC and Nkm are applicable to predict risk of AIS1neck injury, while NDC and lower neck moment were found to be less applicable. The risk of a NIC above 15 m2/s2 and a Nkm above 0.7 was found to be zeroing at mean accelerations below 4g.

Paper No.99-O

A Comparison of Injury Criteria Used in Evaluating Seats for Whiplash Protection

Allan Tencer, Sohail Mirza,
Phillipe Huber, University of Washington
United States

Abstract

A protocol has been proposed for testing of seats for whiplash protection, however injury criteria were not chosen. We used a cadaver model based on volunteer testing to determine the correlation between intervertebral motions and injury criteria. A displacement injury criterion, Nd, had better correlation, compared with force (Nkm, Nte) or acceleration (NIC) criteria.

Paper No.229-O

The Role of Seatback and Head Restraint Design Parameters on Rear Impact Occupant Dynamics

Michael Kleinberger, Liming Voo,
Andrew Merkle, Matthew,
Shin-Sung Chang Bevan
Johns Hopkins University Applied
Physics Laboratory
Felicia McKoy, Computer Systems
Management, Inc., United States

Abstract

A series of sled tests was conducted to evaluate the effects of seatback recliner stiffness, cushion stiffness, and head restraint height and backset on occupant response in rear impact. Results indicate that head restraint effectiveness should be evaluated along with seatback characteristics, and that occupant dynamics are dependent on a combination of factors related to both seatback and head restraint design.

Paper No.504-O

An evaluation of existing and proposed injury criteria with various dummies to determine their ability to predict the levels of soft tissue neck injury seen in real world accidents

Frank Heitplatz, Raimondo Sferco,
Joerg Reim
Ford of Germany
Germany
Paul Fay
Ford of Britain
United Kingdom
Agnes Kim, Priya Prasad
Ford of US
United States

Abstract

This study investigated the ability of various dummies and injury criteria to correlate to retrospective real world data. Four vehicles with either a particular low or high rate of long term STNI claims in the field were chosen. Sled test were conducted with BioRID II, RID2 and Hybrid III dummies. In conclusion, using RID2 as the dummy and the LNL-index as the injury criterion is proposed as the preferred option for future STNI evaluation.

Technical Session

Advanced Technology #2: Driver-Vehicle Safety/Driver Performance

Oral Presentations
Wednesday, May 21, 2003
09:00 - 12:30

Chairperson: Bernd Friedel, Germany

Room: Track A: Hall 1

Paper No.170-O

Drivers' load of voice interaction system in vehicles

Yonosuke Miki
Nissan Motor Co., Ltd
Japan

Abstract

This paper describes the effectiveness of voice recognition system in vehicles by testing various drivers or vehicles behavior in the driving simulator and also in the real world. The results indicate that the drivers' load of using the voice interaction system is apparently lower than usual operational system which requires drivers hands and eyes movements.

Paper No.145-O

Development of a Technology to Prevent Deviation from the Intended Lane when Turning Using Vehicle Dynamics Control

Kyuyong (Keiyuu) Kim (Kin), Hiroshi Sekine
Honda R&D Co., Ltd.
Osamu Yano, Hiroyuki Sugishita
PSG Co., Ltd., Japan

Abstract

The research described in this paper attempted to provide a solution by developing a technology to reduce accidents by controlling the amount of deviation through optimal control of moment and velocity. This technology estimates vehicle dynamics parameters and applies four-wheel slip control. Results have shown that the logic is effective in reducing the likelihood of accidents.

Paper No.529-O

A Lane Keeping Assist System for Passenger Cars - Design Aspects for the Driver Interface

Jochen Pohl, Jonas Ekmark
Volvo Car Corporation
Sweden

Abstract

The lane keeping assist system described here is intended to be an active safety system, thus aiming at decreasing the amount of unwanted lane departures. The challenge in the development is to find the "correct code of communication" between human and machine.

Paper No.405-O

Rear-end Collision Avoidance Assist System

Kenji Kodaka, Makoto Otabe,
Yoshihiro Urai, Hiroyuki Koike
Honda R&D Tochigi Center
Japan

Abstract

An analysis of rear-end collisions in Japan was carried out through traffic accidents analysis. The results indicate a high possibility that such accidents are caused by momentary inattention during daily driving. A collision avoidance assist system was researched that uses warnings and brake control, which are effective in such circumstances.

Paper No.267-O

Broadside collision scenarios at uncontrolled intersections

Machiko Hiramatsu, Hideo Obara,
Hiroshi Ueno, Kenjou Umezaki
Nissan Motor Co., Ltd
Japan

Abstract

The probability of a broadside collision occurring under each driving pattern was estimated using Bayes rule. Drivers traveling straight ahead, a pattern that accounts for a high share of broadside collisions, showed a tendency to collide with right-of-way vehicles coming from the left. Various conceivable causes were considered, and the most probable factors coinciding with those causes were extracted.

Paper No.181-O

Safety of light commercial vehicles in the light of the results of real world crashes and laboratory testing

Alexander Berg, Peter Ruecker
DEKRA Automobil GmbH
Raimondo Sferco, Tilman Schriever
Ford Motor Company, Germany
Paul Fay, Ford Motor Company
United Kingdom

Abstract

Light commercial vehicles are becoming more important in the European vehicle fleet, leading to a growing public interest in the safety of these vehicles. The presentation gives an overview about the current accident occurrence involving vans in Germany and represents the results of two crash tests with a Ford Transit. The tests were in accordance to the FMVSS 208/301 standard and the ECE-R 93 regulation.

Paper No.522-O

Driver Performance Evaluation of Two Rear Parking Aids

Shane McLaughlin, Jon Hankey
Virginia Tech Transportation Institute
Charles Green, Raymond Kiefer
General Motors, United States

Abstract

Four levels of rear parking aids were tested using 32 participants. Levels of parking aid were: no aid, a video system, ultrasonic park assist system with an auditory/visual "distance to object" interface, and a combination system of these two latter levels. Using a sport-utility vehicle, drivers performed five parking tasks: entering and exiting a parallel space, entering and exiting a perpendicular space, and backing to a trailer hitch. Subjective and driver performance measures are reported, including eye gaze analysis.

Paper No.381-O

Assessing the Safety Benefit of Automatic Collision Avoidance Systems

Beshr Sultan, Mike McDonald
University of Southampton
United Kingdom

Abstract

The safety benefit of ACAS was assessed, by examining drivers response during emergency braking situations. Tests were performed from variable speed levels to avoid collision with a decelerated lead vehicle. The analysis showed that drivers would initiate their braking before an autonomous ACAS with a 4 second TTC threshold would give any warning.

Paper No.259-O

Evaluation of Indirect Tire Pressure Monitoring Systems Using Data from NHTSA's Tire Pressure Special Study

Kristin Thiriez
National Highway Traffic
Safety Administration
United States

Abstract

NHTSA's National Center for Statistics and Analysis conducted a tire pressure study in February 2001 and built a database of over 11,000 vehicles. There are two types of tire pressure monitoring systems, direct and indirect. This paper will discuss how the data from NHTSA's study was used to simulate the effectiveness of an indirect tire pressure monitoring system.

Paper No.84-O

The safety impact of substituting manual operation of in-vehicle tasks with voice control

Arihiro Isomura
Mitsubishi Motors Corporation
Japan

Abstract

The safety impact of voice operation of in-vehicle tasks was examined in this study. For the operation of audio and navigation systems, a greater lane deviation was observed in a simulator study when executing those in-vehicle tasks manually than using voice-control functionalities. The curvature of the road and type of voice operation were used as dependent variables to control the driver workload.

Paper No.423-O

Rider acceptance of advanced safety technology. A basic requirement for improved safety. Concept, experience and results of a multimedia communication campaign on antilock motorcycle brakes

Hubert Koch
Dr. Koch Consulting GmbH
Germany

Abstract

Advanced safety technology needs to be accepted by drivers. Based on problem analysis, the paper describes a multidisciplinary and multimedia information and motivation campaign, which is indented to change motorcycle riders' attitude towards antilock brakes. The objective is to increase riders' acceptance.

Paper No.410-O

PRE-SAFE - The next Step in the Enhancement of Vehicle Safety

Rodolfo Schoeneburg, Karl-Heinz Baumann,
Rainer Justen
DaimlerChrysler AG Author
Germany

Abstract

A new way for the improvement of vehicle safety has been found with PRE-SAFE, embedded in Mercedes-Benz's integrated safety concept. PRE-SAFE uses the time prior to an accident to provide preventive safety to occupants. First PRE-SAFE elements are on there road today, and more will follow with the introduction of individual safety and environment sensing.

Technical Session

*Developments in Side Impact Protection

Oral Presentations
Wednesday, May 21, 2003
09:00 - 12:30

Chairperson: Keith Seyer, Australia

Room: Track B: Hall 2

Paper No.579-O
Side Impact Working Group Status Report

Keith Seyer
Chairman, IHRA Side Impact
Working Group
Australia

Abstract

This paper reports on the status of work of the International Harmonised Research Activities (IHRA) Side Impact Working Group (SIWG) as at its 17th meeting prior to the 18th ESV conference in Nagoya in May 2003. This includes decisions made and the reasons for them.

Paper No.328-O
Investigation of new side impact test procedures in Japan
Hideki Yonezawa, National Traffic Safety and
Environment Laboratory

Minoru Sakurai, Takeshi Harigae
Japan Automobile Research Institute
Toshiyuki Nishimoto, Ministry of Land
Infrastructure and Transport
Hiroko Minda, Japan National Traffic
Safety and Environment Laboratory

Abstract

In recent years there has been a strong shift away from sedans to multipurpose vehicles. Considering current situation including issue mention above, reviewing the test procedures in current regulations has become a matter of some urgency. This report describes full-scale side impact tests carried out with multipurpose vehicles, which have a different front shape and stiffness than sedans, as the striking vehicle.

Paper No.138-O

Development of a European Side Impact Interior Headform Test Procedure

Michiel van Ratingen, TNO Automotive
Ton Versmissen, Safety, TNO Automotive
Netherlands
Adrian K. Roberts, Richard W. Lowne
TRL, United Kingdom
Ulf Lechelt, Volvo Cars, Sweden
Tobias Langner, BAST, Germany

Abstract

The paper presents the final proposal for the EEVC interior headform test procedure to evaluate potential areas of head contact inside the vehicle in side impact. It presents the rationale for the test and gives results of tests carried out using the proposed test protocol on different models of cars.

Paper No.172-O

Insurance Institute for Highway Safety Side Impact Crashworthiness Evaluation Program: Impact Configuration and Rationale

Gregory J. Dakin, Raul A. Arbelaez,
Joseph M. Nolan, David S. Zuby,
Adrian K. Lund, Insurance Institute
for Highway Safety, United States

Abstract

The new Insurance Institute for Highway Safety (IIHS) side impact crashworthiness evaluation program is based on a test in which stationary vehicles are struck perpendicularly at 50 km/h by a 1500 kg IIHS barrier. Injury risk is predominately assessed by measures from two SID-IIs dummies. The crash tests and field investigation data that dictated the impact configuration of the IIHS side impact test are discussed.

Paper No.492-O

NHTSA Side Impact Research: Status and Update

Randa Radwan Samaha
Department of Transportation/National Highway
Traffic Safety Administration
Daniel S. Elliott
Abacus Technology Corporation
United States

Abstract

This paper presents an overview of NHTSA's current side impact research activities. The research encompasses data analyses, static out-of-position air bag tests, and crash tests to support development of upgraded test procedures and incorporation of advanced dummies.

Paper No.126-O

The development of the Advanced European Mobile Deformable Barrier Face (AE-MDB)

Adrian Roberts
EEVC WG13
United Kingdom

Abstract

IHRA-SIWG is co-ordinating research that will lead to more advanced side impact procedures. One of which will be based on a full-scale test using an impact trolley and new deformable barrier face, reflecting current vehicle design. The European input into these developments is being provided through EEVC WG13. The paper presents the status of WG13 research on the development of the advanced barrier (AE-MDB).

Paper No.530-O

Ejection through side windows: relevance and countermeasures

Vittorio Giavotto
Politecnico di Milano
Italy

Abstract

A research is referred on the relevance of ejection through side windows in Northern Italy. It is found that safety belt are not effective in preventing partial ejection through side windows, that can be a relevant risk in collision with safety barriers. Full scale tests, laboratory tests, and computational mechanics are performed to complete the investigation. Stratified glass and/or head curtain air bags are possible countermeasures. Improvement in crashworthiness regulations are also recommended.

Paper No.100-O

Side Airbag Deployments in the UK – Initial Case Reviews

Alan Kirk
Vehicle Safety Research Centre
Andrew Morris
Vehicle Safety Research Centre
United Kingdom

Abstract

This study adds to the body of knowledge on real world side impacts by presenting initial in-depth cases from the UK where there is some suggestion that side airbag deployment may have caused injury. In the majority of the cases side airbag deployment did not cause injury to the occupant and a general overview of these cases is given. However case reviews identified 3 occupants where serious (AIS 3) injuries may have occurred from a deploying side airbag.

Paper No.219-O

The role of impact velocity and change of velocity in side impacts

Claes Tingvall, Anders Lie
Swedish National Road Administration
Maria Krafft, Anders Kullgren
Folksam Research
Claes Tingvall, Swedish National Road
Administration and Monash University
Accident, Research Centre, Sweden

Abstract

Impact velocity in side impacts is normally seen as the main injury risk related parameter. By using an advanced form of matched paired comparison, the individual role of impact velocity and change of velocity during impact could be studied. It was found, that the change of velocity is equally important as impact velocity.

Paper No.266-O

Side Impact Sled Test Methodology for Investigation to Reduce Injury Index

Hitoshi Ikeno, Mafuyu Kada,
Naoyuki Uzuki, Mitsubishi Motors
Corporation, Japan

Abstract

Sled tests using HYGESLED facility were carried out to simulate the thoracic behavior of dummy in the side impact situation of a SUV representative impacting a passenger car side. Even if the sled moves in normal V-T profile used in HYGESLED facility, the dummy responses are well enough correlated with full vehicle tests. This test methodology can be applied for both Eurosid and SID2s dummies.

Paper No.447-O

Countermeasures to Address Far-Side Crashes: First Results

Brian Fildes, Monash University Accident
Research Centre
Laurie Sparke, Holden, Australia
Ola Bostrom, Autoliv Research, Sweden

Abstract

A series of side impact crash tests was undertaken to demonstrate the benefits of a range of countermeasures for protecting far-side occupants. The results showed that 3+2 seat belts, sash pretensioners and seat supports all provided increased protection, especially in combination. Directions for further research are included.

Paper No.448-O

Validating Lower Limb Injury Mechanisms in Side Impact Crashes

Naomi Arndt, Raphael Grzebieta,
Roger Zou, Department of Civil Engineering,
Monash University, Australia

Abstract

Lower limb injuries sustained in side impact car crashes are debilitating, costly and no regulations exist to mitigate their injuries. This paper describes the three injury mechanisms identified from real world cases and results of MADYMO computer simulations carried out to validate them. Possible injury countermeasures for these three side-impact configurations are also discussed.

Technical Session

*Improved Safety for Vulnerable Road Users

Oral Presentations
Wednesday, May 21, 2003
09:00 - 12:30

Chairperson: Yoshiyuki Mizuno, Japan
Room: Track C: Room 431 & 432

Paper No.580-O

IHRA-Summary of IHRA Pedestrian Safety Working Group Activities (2003)

Yoshiyuki Mizuno
Japan Automobile Standard
Internalization Center
Japan

Abstract

This is the Summary Report of IHRA Pedestrian Safety Working Group activity, which were completed in the past and will be completed in the near future.

Paper No.289-O

Effects of Vehicle Front Design Parameters on Pedestrian Head-Brain Injury Protection

Jikuang, Yang
Department of Machine and Vehicle
Sweden

Abstract

The effects of car front design parameters on pedestrian head-brain injuries were analyzed by accident reconstructions and simulations of car-pedestrian impacts with pedestrian models of 6, 9 years old child and 5th, 50th, 95th adults. The conflict of pedestrian safety and vehicle design was analyzed with focus on the head impact velocity, head impact angle, location and timing of head impact.

Paper No.378-O

Development of a Biofidelic Pedestrian Legform Impactor

Atsuhiko Konosu,
Japan Automobile Research Institute
Masaaki Tanahashi
Japan Automobile Manufacturers
Association, Inc., Japan

Abstract

In this study, a pedestrian legform impactor was developed which has bone flexibility and actual knee ligament structure. The legform response was close to the human one, and high potentials for the car assessment for the pedestrian leg injury were demonstrated.

Paper No.429-O

Evaluation of the response of computational and physical pedestrian knee joint models to bending and shear loading

Kavi Bhalla, Dipan Bose,
N. Jane Madeley, Jason Kerrigan,
Jeff Crandall, University of Virginia
Yukou Takahashi, Honda R&D Co.,
Tochigi R&D Center, Japan
Douglas Longhitano, Honda R&D
Americas, Inc., United States

Abstract

The response of the EEVC legform, an anthropomorphic leg test device, the MADYMO multi-body pedestrian knee joint and the finite element knee joint of the H-model is compared with results from dynamic, lateral-medial, bending and shear loading of cadaveric knees.

Paper No.503-O

Introduction of the Regulation of Pedestrian Head Protection in Japan

Toshiyuki Nishimoto
Ministry of Land, Infrastructure and
Transport
Japan

Abstract

The number of pedestrian related fatal accidents is about 30% of fatal accidents in Japan. Because head injuries often lead to death or serious injuries, we especially need to reduce the number of fatalities and injuries caused by head injuries. Accordingly, a new head protection regulation is currently being processed.

Paper No. 151-O

Development of Finite Element Model for Child Pedestrian Protection

Masayoshi Okamoto, Yukou Takahashi,
Honda R&D Co., Ltd. Tochigi Center
Masahito Hitosugi, Dokkyo Univ.
School of Medicine
Fumie Morie, PSG Co., Ltd., Japan
Jane Madeley, Johan Ivarsson,
Jeff Crandall, University of Virginia
United States

Abstract

A preliminary child pedestrian finite element model was developed to study a child pedestrian kinematics phenomenon, injury mechanisms and injury criteria in the future. The model is based on MRI scans from a 6-years-old child. Properties and validations referred to published papers. Kinematics of the simulation model was compared with the papers and the result proved good possibilities.

Paper No. 468-O

Pedestrian crash reconstruction using multi-body modeling with geometrically detailed, validated vehicle models and advanced pedestrian injury criteria

Lex van Rooij, Kavi Bhalla,
Mark Meissner, Johan Ivarsson
Jeff Crandall, University of Virginia
Douglas Longhitano,
Honda R&D Americas, Inc.
United States
Yukou Takahashi, Yuuji Kikuchi
Honda R&D Co., Ltd., Japan

Abstract

Advanced multi-body pedestrian impact modeling techniques using vehicle geometry and stiffness characteristics based on Finite Element models are discussed. Advanced injury criteria are proposed. The techniques are applied to reconstruction of two real world pedestrian impacts.

Paper No.165-O

Development of Future Pedestrian Protection Technologies

Tetsuo Maki, Toshiyuki Asai
Nissan Motor Co., Ltd., Japan
Janusz Kajzer, Kabimec Consulting
Sweden

Abstract

This paper describes two future pedestrian protection technologies that have less influence on vehicle design. One is a "rear-rising hood" that increases the energy-absorbing space at the time of a vehicle-pedestrian collision. The other is an "airbag system for controlling pedestrian collision behavior" that reduces the head impact velocity against the vehicle by controlling the behavior of a pedestrian.

Paper No.142-O

Estimation of benefits resulting from impactor-testing for pedestrian protection

Alexander Berg, Markus Egelhaaf
DEKRA Automobil GmbH
Ebner Hans-Thomas, VDA Frankfurt
Germany

Abstract

The presentation gives an overview about the historic and actual situation of the pedestrian accident occurrence. The approaches to achieve the European target in reducing the number of fatalities by 30% and of seriously injured pedestrians by 17% by 2010 are described. The possible benefits resulting from the EEVC proposed impactor-testing are evaluated and set in relation to the advantages expected by an increase of active safety.

Paper No.157-O

Modeling of a Motorcycle for Collision Simulation

Motoaki Deguchi
Yamaha Motor Co., Ltd.
Japan

Abstract

This paper describes modeling of a motorcycle for collision simulation with an automobile using MADYMO software. As a motorcycle model, a scooter-type motorcycle with an airbag system was selected. And this research comprises component tests to determine the impact characteristics of the motorcycle, prescribed motion simulations, a barrier test to validate its simulation.

Paper No.40-O

**FE Simulations of Car-Motorcycle Frontal Crashes,
Validation and Observations**

ANoop Chawla, Sudipto Mukherjee,
Dinesh Mohan, Dipan Bose,
Prakash Rawat, Indian Institute of
Technology, Delhi, India
Tamotsu Nakatani, Minoru Sakurai
Japan Automobile Research Institute
Japan

Abstract

This paper reports Finite Element (FE) based simulations of the three frontal impact configurations mentioned in ISO 13232 and their detailed analysis.

Technical Session

*Advanced Intelligent Technologies - ITS

Oral Presentations
Wednesday, May 21, 2003
14:00 - 17:30

Chairperson: Y. Ian Noy, Canada
Room: Track A: Hall 1

Paper No.581-O

IHRA – Report of Working Group on Intelligent Transport Systems (ITS)

Ian Noy, Peter C. Burns
Transport Canada
Canada

Abstract

The International Harmonized Research Activities Working Group on Intelligent Transport Systems was established to coordinate government research aimed at developing harmonized procedures for the evaluation of safety of in-vehicle information, control and communication systems with respect to human performance and behaviour. This report describes some of the activities completed in recent years and recommendations are provided for the future success of the WG.

Paper No.242-O

State-of-the-art of the SNRA/JARI/BASt joint research on driver workload measurement within the framework of IHRA-ITS

Christhard, Gelau, Federal Highway
Research Institute, Germany
Georg Jahn, Josef F., Krems, Chemnitz
University of Technology, Germany
Hitoshi, Uno, Japan Automobile
Research Institute, Japan
Kircher Albert, Joakim Ostlund,
Nilsson Lena, VTI, Sweden

Abstract

The present paper describes a joint Swedish-German-Japanese research project performed under the umbrella of IHRA-ITS. This project aims at the development and validation of secondary techniques as tools to assess driver workload and distraction caused by in-vehicle information and communication systems. Actual results are reported and discussed.

Paper No.261-O

The effectiveness of ESP (Electronic Stability Programme) in reducing real life accidents

Claes Tingvall, Swedish National Road
Administration And Monash University Accident
Research Centre
Maria Krafft, Anders Kullgren,
Folksam Research
Anders Lie, Swedish National Road
Administration, Sweden

Abstract

ESP (Electronic Stability Programme) has recently been introduced on the market to reduce the number and severity of loss-of-control accidents. In this study, the effectiveness of ESP in real life accidents was studied by using induced exposure. The results of the study are promising showing reductions of accidents on low friction roads.

Paper No.305-O

Using Parameter Optimization To Characterize Driver Performance in Rear-End Driving Scenarios

August Burgett, Bob Miller
National Highway Traffic Safety
United States

Abstract

This paper describes a parameter optimization method to mathematically describe driver performance in rear-end driving scenarios. The method produces the best estimate of the two parameters, the time at which the driver begins to brake and the level of deceleration. The method is applied to a portion of the baseline data generated by research carried out under the Crash Avoidance Metrics Partnership program.

Paper No.308-O

Characterization of a Single-Vehicle Road Departure Avoidance Maneuver

Peter Martin, August Burgett,
Gowri Srinivassan
National Highway Traffic Safety
United States

Abstract

A method to mathematically characterize the trajectory of a vehicle during a road departure event is presented.

Paper No.211-O

Development of ACC For Vehicle With Manual Transmission

Kenta Kubota
Nissan Motor Co., Ltd
Japan

Abstract

ACC system has been developed and carries out the spread of various vehicles. This paper explains MT vehicle equipped with outline of ACC along with the investigation and the results of driving tests. Especially the mental workload reduction was evaluated. In addition, characteristic problems and its solutions were introduced in this paper.

Paper No.334-O

Market Response to Adaptive Cruise Control

Satoru Yahagi, Yoko Yanaj
Nissan Motor Co., Ltd
Japan

Abstract

We Nissan started introducing its ACC in 1999, and now, a lot of Nissan's ACC vehicles are used by the customers at various markets. To determine the actual market response to ACC for use as a reference for future development, we conducted a survey of ACC customers in the Japanese market. In this paper, we will provide an explanation of the survey as well as an outline of the results.

Paper No.352-O

A Balanced Active and Passive Safety Technology Concept for new Vehicle Generations

Klaus Werkmeister, Nils Borchers
BMW Group, Germany

Abstract

For most of the current vehicles on the road - safety was developed with the predominant focus of applying the best crash protection to occupants. With a soon to be introduced vehicle a new philosophy has been applied. Additional options have increased performance of electronic devices. A concept has been developed in which safety measures are applied throughout all relevant phases of the vehicle in traffic.

Simulation of Driver, Vehicle and Environmental Aspects of Crash Initiation - A New Method to Improve Integrated Safety Effectiveness

Robert Wood, Abs Dumbuya, Qian Zhao
Traffic Modelling and Simulation Group
United Kingdom
Pete Thomas, Julian Hill
Vehicle Safety Research Centre
United Kingdom

Abstract

The development of effective advanced active safety technologies requires a close understanding of the pre-crash events and the initiating conditions. The paper describes a new approach to pre-crash simulation where driver perceptions, fields of vision, driving style and decision making are modeled in the context of the road and traffic environment and the vehicle dynamic performance.

Paper No.188-O

Safety Evaluation of Forward Obstacles Collision Avoidance Support Service using Driving Simulator

Kiichi Yamada, Takashi Wakasugi
Automobile Research Institute
Japan

Abstract

Various warning systems are being studied in the world to improve traffic safety. To enhance the information/warning systems, systems that are based on sensors installed on the roadside are under research, especially in Japan. We have introduced new evaluation criteria and evaluated effectiveness of the forward obstacles collision avoidance support system using the driving simulator (DS) in Japan Automobile Research.

Paper No.392-O

Potential Effects of Automatic Crash Notification (ACN) on Air Medical Services: Trauma Scene Transport Utilization Patterns

Alan Blatt, Marie Flanigan, Veridian
Brooke Lerner, University of Rochester
Medical Center
Dietrich Jehle, Erie County
Medical Center
Louis Lombardo, National Highway
Traffic Safety Administration, United States

Abstract

The commercial availability of Automatic Crash Notification systems is increasing. This paper reports on patterns of ground and air trauma scene transports. Assessments are provided for the potential effect of ACN data on the definition and refinement of ground vs. air zones.

Paper No.80-O

Paper No.356-O

Protecting Small Cars and Severe Crashes-Smart Structure Solution

Saad Jawad
University of Hertfordshire
United Kingdom

Abstract

This research seeks to adjust the deformation properties of the frontal structure by introducing 'hydraulic smart structures' within the front part of the main longitudinal members. The benefits are increased energy absorption capacity, and collision-friendly deformation properties to provide load controllability and help adapt to varying collision conditions. Significant reduction in the passenger compartment G-level as well as intrusion injury risk is expected with the integral use of "Smart structures" in the impacted vehicle (smart vehicle) or the partner vehicle for structural compatibility consideration.

Technical Session

Child Restraint Systems

Oral Presentations
Wednesday, May 21, 2003
14:00 – 17:30

Chairperson: Jac Wismans, The Netherlands

Room: Track B: Hall 2

Paper No.85-O

Relative Degradation of Safety to Children when Automotive Restraint Systems are Misused

Simone Lalande, France Legault
Transport Canada
Jocelyn Pedder, RONA Kinetics and
Associates Ltd., Canada

Abstract

The purpose of the project was to determine the relative degradation of safety to children when automotive child restraint systems are misused in the most common modes. Transport Canada conducted forty-six sled tests using instrumented child test dummies. The results will be used to identify ways of improving child restraint regulations to ensure that some degree of safety will be retained when common misuse occurs.

Paper No.275-O

Child safety: whose move is it?

Cees Huijskens, TNO Automotive
Ronald Vroman, Consumentenbond
Netherlands

Abstract

Reviewing the facts about child safety today, it is no longer justifiable to approve an interchangeable CRS as an universal safety product for all type of passenger cars, because the loading of child restraint systems is completely different in a passenger car test (Euro NCAP) than in a standard sled test (ECE Regulation 44).

Paper No.420-O

Differences in Air Bag Performance with Children in Various Restraint Configurations and Vehicle Types

Rajiv A. Menon, Kristy B. Arbogast
The Children's Hospital of Philadelphia
John Cooper, Mohammad Murad, Stephen A. Ridella,
Richard Barnes
Automotive Occupant Restraints Council
Michael J. Kallan, Flaura K. Winston
The University of Pennsylvania
United States

Abstract

A child-specific, crash surveillance database was used to identify risk of injury in children exposed to passenger airbags. Sled testing and modeling with child crash dummies confirmed data base results, but found that certain sub-optimally restrained children may benefit from air bag deployment. Implications for dummy design and air bag suppression are discussed.

Paper No.474-O

Evaluation of child restraints for Holden Commodores

Judith Charlton, Brian Fildes, Ted Olsson,
Niklas Truedsson, Monash University Accident
Research Centre
Stuart Smith, Jo Kobus, Holden Ltd
Paul Kelly, Consultant
Australia

Abstract

This study was conducted to evaluate a range of child restraints available in Australia for their suitability to fit a Holden commodore vehicle. Although findings showed that the CRS offered a good level of protection, several areas for improvement in design were highlighted.

Paper No-495-O

The significance of ISOFIX in reducing misuse -Analysis of potential on the basis of field observations and sled tests

Klaus Langwieder, Thomas Hummel,
Fritz Finkbeiner, Thomas Roselt
German Insurance Association;
Institute for Vehicle Safety
Germany

Abstract

An observation study of the GDV revealed that two thirds of children are secured incorrectly in the child seats (CRS) or the CRS is not installed properly (misuse). The report will assess how far ISOFIX, an installation system that should allow the CRS to be fitted simply and correctly can actually avoid "misuse" and if a higher level of protection can be expected. The effect of an anti-rotation device in conjunction with two ISOFIX low anchorages is also discussed.

Paper No.345-O

Investigation of the Protection of Children in Minibuses and Coaches

Rachel Grant, Ruth Welsh, Alan Kirk
Vehicle Safety Research Centre
United Kingdom

Abstract

With regard to protection of children in minibuses and coaches existing UK, crash injury and exposure data will be analysed; operational issues of use and practicality of restraint systems will be considered; and the fit of existing seatbelt systems for different age groups of children will be evaluated. This information will enable judgments to be made about the level of protection currently afforded to children.

Paper No.193-O

Protecting Children in Car Crashes: the Australian Experience

Michael Paine, Vehicle Design & Research
Michael Griffiths, Julie Brown
Road Safety Solutions
Michael Case, Royal Automobile Club of Victoria
Owen Johnstone, National Roads and
Motorists Association, Australia

Abstract

The child restraint designs used in Australia have been shown to provide exceptional protection to child occupants in severe crashes. This paper reviews the history of development of child restraints in Australia and research that has been undertaken to ensure that children receive the best possible protection.

Paper No.241-O

Child Restraint System Assessment Program in Japan

Yuji Ono, Takahiro Hosono
National Organization for Automotive
Safety & Victims' Aid
Yuji Kimura, Ministry of Land,
Infrastructure and Transport
Osamu Takatori, Japan Automobile
Research Institute, Japan

Abstract

This paper provides a brief profile of a Japan's child restraint system (CRS) assessment program which initiated in 2001. The CRS assessment program was launched in order to assess universal CRSs under the increasing tendency of killed and injured child occupants in recent years as well as the introduction of a regulation in April 2000 which mandates use of CRSs for less than 6-year-old children.

Paper No.302-O

Special Crash Investigations of Restrained Child Occupants

JoAnn Murianka, Michael Parsons
US Dept. of Transportation
United States

Abstract

The Special Crash Investigation office investigates special interest child occupant cases to assess injury outcomes to children in real-world crashes.

Technical Session

Biomechanics #2: Injury Criteria and Dummy Development

Oral Presentations
Wednesday, May 21, 2003
14:00 - 17:30

Chairperson: Dominique Cesari, France
Room: Track C: Room 431 & 432

Paper No.306-O
Injury Survivability

Peter Martin, Rolf Eppinger
National Highway Traffic
Safety Administration
United States

Abstract

A procedure to estimate the survivability of injuries sustained by crash victims is presented.

Paper No.473-O
Analysis of Computer Models for Head Injury Investigation

Ramesh Dwarampudi, Liying Zhang,
King Yang, Bioengineering Center,
Wayne State University
Rolf Eppinger, National Highway Traffic
Safety Administration, United States

Abstract

Previous studies have shown that both excessive linear and rotational accelerations are the cause of head injury. As HIC considers linear accelerations only, the objective of the current study was to consider both linear and rotational motion by evaluating two models of the head/brain complex. To provide input data for the models, real-world cases were used to perform full crash reconstructions.

Paper No.78-O

The Development of an Injury Criteria for Axial Loading to the THOR-Lx Based on PMHS Testing

David Hynd, Claire Willis, Adrian Roberts,
Richard Lowne, TRL Limited
Richard Hopcroft, Paul Manning,
W Angus Wallace, University of Nottingham
United Kingdom

Abstract

Fifteen PMHS lower limbs have been impacted in a car-equivalent manner using a dual impact sled rig. The sled reproduces both the vehicle deceleration and footwell intrusion phases of a frontal impact at a range of severities. The injuries generated and described here are representative of those seen in car accidents. Repeat tests with a THOR-Lx have lead to the development of an injury risk curve for the dummy leg.

Paper No.160-O

Assessment of the Biofidelity Thor and Hybrid III ATD Knee-Thigh-Hip Complexes in Frontal Impacts

Jonathan Rupp, Matthew Reed,
Nathaniel Madura, Lawrence Schneider
University of Michigan Transportation
Research Institute
Shashi Kuppa, National Highway Traffic
Safety Administration, United States

Abstract

The knee-thigh-hip and knee/femur responses of human cadavers are documented and compared to the knee-thigh-hip and knee/femur responses of the Hybrid III and Thor ATDs.

Paper No.491

Fifth Percentile Female Hybrid III and Thor-FLx Performance in Sled Tests with Toe-pan Intrusion

Rodney Rudd, Jeff Crandall,
Greg Shaw, University of Virginia
United States

Abstract

Sled tests with toe-pan intrusion were performed with a 5th percentile female Hybrid III dummy with Hybrid III/Denton and Thor-FLx legs.

Paper No.343-O

New Method For Biofidelity Evaluation of Dummy Necks

Willinger Remy, Bourdet Nicolas,
Fischer Raphael, Strasbourg University
Le Gal Francois, TREVES, Reims, France

Abstract

Modal analysis technique is used in order to characterize the human head-neck system in vivo. The extracted modal characteristics consist of a natural frequency at 1.4 Hz associated to neck extension and a second mode at 5 Hz associated with neck retraction. By recording experimentally the apparent mass of dummies head-neck system under the same experimental condition, it was possible to evaluate their biofidelity.

Paper No.333-O

Modification and Validation of Human Neck Model under Direct Head Loading

Susumu Ejima, Koshiro Ono,
Kunio Yamazaki, Japan Automobile Research Institute
Adam Wittek, Toyota Central Research and Development
Laboratories (Study done at JARI), Japan

Abstract

In this study, we investigated the effects of the selected properties of flesh, trachea, vena cava, muscle action and cervical spine initial alignment on responses of the H-Model of cervical spine under direct loading applied to the head. The modeling results were compared with those of volunteers.

Paper No. 425-O

Development of an Advanced 50th Percentile Male Head/Neck System for Application to Crash Test Dummies

T.J. Huang, T. Shams, GESAC, Inc.
M. Haffner, R. Eppinger
National Highway Traffic
Safety Administration, United States

Abstract

An advanced 50th percentile male head/neck system has been developed which can duplicate the responses of human head/neck kinematics and dynamics during multi-directional impacts. This head/neck system was based on the head and neck originally designed for the THOR Alpha advanced frontal dummy. The new system can be utilized directly on the THOR dummy, but can also be retrofitted to the standard Hybrid III dummy.

Paper No.218-O

Advanced FE Lower Limb Model for Pedestrians

Yukou Takahashi, Yuji Kikuchi
Honda R&D Co., LTD.
Fumie Mori, PSG Co., LTD.
Atsuhiko Konosu, Japan Automobile
Research Institute, Japan

Abstract

The goal of this study was to develop a FE lower limb model for pedestrians that can be used for direct and accurate injury prediction. 3D geometry was determined from MRI scans. The impact response of the bone models was validated against the dynamic 3-point bending tests with different loading points. An experiment using only the knee portion of the human subject was used for knee joint model validation.

Paper No.322-O

Validation of the Human Head FE Model against Pedestrian Accident and Its Tentative Application to the Examination of the Existing Tolerance Curve

Yasuhiro Dokko, HONDA R&D Co., Ltd., Japan
Robert Anderson, Jim Manavis, Peter Blumbergs,
Jack McLean, The University of Adelaide, Australia
Liyang Zhang, King Yang, Albert King,
Wayne State University
United States

Abstract

The head/brain FE model was validated against three actual pedestrian accidents and was tentatively used to show its capability for injury mechanism analyses. A number of combinations of translational acceleration and its duration time were parametrically examined around the existing head injury tolerance curve, and several numbers of simulations with pure rotational motions were also tried.

Paper No.72-O

**Development of an Age-Dependent Thoracic Injury
Criterion for Frontal Impact Restraint Loading**

Richard Kent, Jim Patrie, University of Virginia
Christina Mullen, Toyota Motor Corporation, United States
Frederique Poteau, University of Virginia, France
Fumio Matsuoka, Toyota Motor Corporation, Japan

Abstract

Seventy-four human cadaver tests are analyzed to determine the age-related change in maximum chest compression injury threshold.

Paper No.82-O

**Eye Injury Incidence and Mechanisms in Frontal
Automobile Crashes**

Stefan Duma, Mary Jernigan,
Joel Stitzel, Ian Herring
Virginia Tech
United States

Abstract

The purpose of this study was to determine the incidence and mechanisms of eye injuries resulting from frontal automobile crashes. In particular, The NASS database and a new computational model were utilized to determine the effect of depowered airbags on the rate and severity of eye injuries.

Paper 141-O

Airbag Deployments and Ocular Injuries of Occupants

Kunihiro Takahashi, Keio University,
Department of Mechanical Engineering
Naoyuki Suzuki, Ryoji Nakahama
Mitsubishi Motors Corporation
Ken Suzuki, Tomohiro Tobari,
Hiroki Takahashi, Takahiro Nakai,
Graduate School of Keio University
Yuuichi Takizawa, Hiroo Yabe
Toho University, Department of Ophthalmology
Japan

Abstract

The relationship between ocular injuries and airbag deployments are studied experimentally and numerically. A series of airbag deployment tests is made for a fixed plate. The surface of the flat plate is equipped with four pig eyes in vitro and multi load-cells. Serious injuries of corneal endothelial cells were not observed. A simulation model is also developed using PAM-CRASH to verify the test results.

Technical Session

Safety of Heavy Trucks, Buses and Truck Tires

Oral Presentations
Thursday, May 22, 2003
09:00 - 12:30

Chairperson: Cezary Szczepaniak, Poland
Room: Track A: Hall 1

Paper No.215-O
HGV Cab Strength

James Anderson
Cranfield Impact Centre Ltd
United Kingdom

Abstract

An HGV cab strength standard has been developed through a comprehensive procedure involving accident investigation, detailed computer simulations and cab testing program.

Paper No.217-O
Universal Coach Safety Seat

Majid Sadeghi, Cranfield Impact
Centre Ltd, United Kingdom

Abstract

A coach safety seat has been developed which gives protection to occupants for various seating and restraint configurations. Cost and weight increases have been kept to a minimum.

Paper No.243-O
Analysis of Large Truck Accidents in Japan

Kouhei Akiyama, Hino Motors.
Ltd., Japan

Abstract

This paper describes the current overview of large truck accidents in Japan and a road map for further improvement of large truck safety. The analysis was carried out in each fatalities categorized in passenger-car occupants, pedestrians, motorcyclists, large-truck occupants and bicyclists to identify the accidents that we should pay attention to. The results of this analysis will be the concrete basement of considering the passive and active safety measures for large trucks in Japan.

Paper No.296-O

Passenger Casualties in Non-Collision Incidents on Buses and Coaches in Great Britain

Alan Kirk, Loughborough University
Rachel Grant, Richard Bird
Vehicle Safety Research Centre
United Kingdom

Abstract

National statistics and in-depth accident cases in the UK have identified non-collision incidents as being responsible for over 60% of all the killed or seriously injured (KSI) passengers on buses and coaches. This study investigates the size of the problem and why injuries occur. Design and operational changes to reduce the number and severity of casualties in non-collision incidents are also recommended.

Paper No.341-O

Passive Safety of Trucks in Frontal and Rear Collisions with Cars

Alexander Berg, Michael Krehl
DEKRA Automobil GmbH
Lars Riebeck, Dr. Ulrich Breitling
MAN Nutzfahrzeuge AG, Germany

Abstract

The regulation ECE-R 93 defines as minimum requirement a rigid front underride guard for commercial vehicles to prevent cars from underriding in frontal collisions. Against this background, the effect of the energy-absorbing front underride guard of a MAN TG-A series was analysed with two full scale tests: The presentation gives additional information for real-world accidents.

Paper No.363-O

Frontal Collision Safety of Bus Passengers in Japan

Hiroyuki Mitsuishi, Yoshihiro Sukegawa
Japan Automobile Research Institute
Shungo Okano, Japan Automobile
Manufactures Association, Inc.
Hirokazu Nagase, Japan Auto-Body
Industries Association Inc., Japan

Abstract

We are examining the bus crash safety, which considers the actual situation of the bus where the seat belt wearing is not obligation for bus passengers. Sled tests of which the test parameters were seat belt, seat interval, and posture, etc. were done.

Paper No.225-O

An Analysis of Heavy Truck Occupant Protection Measures

Alrik Svenson, National Highway Traffic
Safety Administration
Vasanth Krishnaswami, Daniel Blower
University of Michigan Transportation
Research Institute, United States

Abstract

This paper presents an examination of heavy truck occupant protection measures. It begins with an analysis of crash data and an overview of occupant injury modes. The paper concludes with the proposal of appropriate countermeasures to mitigate the severity of these crashes for the truck occupant.

Paper No.230-O

Research to Evaluate Safety Technologies for Vulnerable Fuel Tanks

Kennerly Digges
Automotive Safety Research Institute
Edward Fournier, Matthew Keown,
Jim Kot, Nicholas Shewchenko
Biokinetics and Associates Ltd., Canada

Abstract

This paper documents crash test programs of more than 30 tests to evaluate the crash performance of fuel systems and technologies to improve performance. The initial testing by NHTSA established the crash conditions under which the baseline design was vulnerable. Subsequent tests, reported in the paper, evaluated technologies to reduce the vulnerability to a 50 mph side impact crash.

Paper No.284-O

Frontal Occupant Safety Simulations for Coach and Bus Passengers

Cees Huijskens, Mark Schrooten,
Peter de Co, TNO Automotive, Netherlands

Abstract

These investigations have lead to an virtual interior assessment with multiple coach occupants, including optimisation of seat design parameters. Models like this can play an important role in identifying the benefit of new designs by application of new test methods and regulations.

Paper No.313-O

Large School Bus Safety Restraint Evaluation – NHTSA

Jeffrey Elias, Transportation Research Center, Inc.
Linda McCray, Lisa Sullivan, National Highway Traffic
Safety Administration, United States

Abstract

This paper details the National Highways Traffic Safety Administration's (NHTSA) research and testing activities on large school bus safety restraints. The results of comparative sled testing for compartmentalization, lap belt, and lap/shoulder belt restraint strategies in a frontal crash are presented. Also, a discussion of test results of an airbag belt system and an additional lap/shoulder belt restraint system.

Paper No.359-O

Protection of bus drivers in frontal collisions

Matyas Matolcsy, Scientific Society of
Mechanical Engineering, Hungary

Abstract

Based on the technical analysis of real bus head on impacts this paper tries to collect the major issues which may help to develop an international regulation in this subject. These are:#61623; the major accident types, endangering the driver compartment (DC)#61623; the possible standard accidents which could be the basis of an approval test #61623; the survival space for the driver, other requirement static or dynamic tests.

Paper No.497-O

Active Safety Of Trucks And Road Trains With Wide Base Single Tyres on Drive Axles Instead Of Twin Tyres

Klaus -Peter Glaeser
Federal Highway , Research Institute, Germany

Abstract

In 1996 the European Commission started the COST1 Action 334 Effects of Wide Single Tyres and Dual Tyres“ for trucks. The main objective of the action was to establish the relative effects of wide base single tyres and dual tyre assemblies in respect of road pavement damage, vehicle operating costs, vehicle safety, vehicle comfort and environmental aspects. This paper only describes the vehicle safety aspects.

Paper No.536-O

Enhanced Safety Of Heavy Vehicles By Use Of Automatic Control Devices

Markus Muser, Working Group on Accident ,

Mechanics, Zurich

Kai-Uwe Schmitt, University and Swiss Federal

Institute of Technology, Switzerland

Wolfram Hell, Institute for Vehicle Safety –

GDV, Munich, Germany

Cezary Szczepaniak, Technical University of Lodz

Andrzej Szosland, Vehicle Research Institute,

Technical University of Lodz, Poland

Abstract

This paper presents the investigations of control of vehicle, which is equipped with an antilocking braking device (ABS) and traction control one (TCS), active suspension (AS) and four wheel steering (4WS). The algorithms of the control of all devices are realised by means of the fuzzy logic method. The obtained results of the simulation, compared with road tests, outline enhancement of vehicle performances while using electronic control.

Technical Session

Developments in Frontal Impact Protection

Oral Presentations
Thursday, May 22, 2003
09:00 - 12:30

Chairperson: Darius Dalmotas, Canada

Room: Track B: Hall 2

Paper No.214-O

Whiplash injuries, not only a problem in rear end impact

Hans Cappon, Jac Wismans, Michiel van Ratingen
TNO Automotive, Netherlands
Wolf Hell, Dina Lang, German Institute for
Vehicle Safety, Germany
Mats Svensson, Chalmers University of
Technology, Sweden

Abstract

Overview and results of the Whiplash 2 project. The focus of the project is on whiplash injuries in rear-end rebound, frontal and oblique impacts.

Paper No.282-O

Designing The Front Frame Rail For Increased Energy Absorption in A Front Offset CAE Analysis

Sameer Gupta, Honda R & D Americas, Inc.
United States

Abstract

The front frame rail structure was studied to identify problem areas in the design. Several design ideas were proposed for improvement, which were simulated. The final structure chosen was due to its ability to absorb more energy in a front offset collision.

Paper No.426-O

Development of an Optical Occupant Position Sensor System to Improve Frontal Crash Protection

Dr. Tie-Qi Chen, Dr. David S. Breed,
Krista Xu, Automotive Technologies
International, United States

Abstract

Considerable research has been initiated to develop countermeasures to mitigate injuries to persons, particularly children, who are present or out-of-position at the time of air bag deployment. This paper reports on the development of a camera based optical occupant position sensor that can be used with multi-stage inflation technologies for modulating air bag deployment.

Paper No.399-O

Evaluation of Crash Types Associated With Test Protocols

Carl Ragland, National Highway Traffic
Safety Administration, United States

Abstract

National Analysis Sampling System data are analyzed to determine the benefits that would likely result from imposed testing requirements using various frontal crash test protocols. These accident data were categorized by test type according to a set of narrowly defined real-world collision orientations. Injury and accident frequency data were then compiled for each crash test protocol.

Paper No.427-O

Injury Risks from Advanced Air Bags in Frontal Static Out-of-Position Tests

Aloke Prasad, Vehicle Research and Test Center
Matthew Maltese, National Highway
Traffic Safety Administration
Allison Loudon, Transportation Research
Center, Inc, United States

Abstract

This paper looks at the findings of the frontal Out-Of-Position (OOP) Airbag testing involving the 3YO, 6YO and 5th female dummies for selected MY2001 vehicles.

Paper No.514-O

Optimal frontal vehicle crash pulses - A numerical method for design

Yibing Shi, Jianping Wu,
Guy Nusholtz, DaimlerChrysler
Corporation, United States

Abstract

For given crash velocity and maximum vehicle crash, with a known arbitrary restraint characteristic, what is the lowest achievable peak occupant deceleration and its corresponding vehicle pulse (i.e., the optimal pulse), subject to lower and upper bounds constraints? This study solves this optimal pulse problem using a numerical model. Convergence studies and practical crash pulse optimization examples are presented. It puts forward a new and effective method that provides guidance in practical vehicle safety design for frontal crash occupant protection.

Paper No.501

Crash Pulse Modeling for Vehicle Safety Research

Michael Varat, Stein Husher
KEVA Engineering, United States

Abstract

Safety researchers use computer simulation, sled tests and component tests to study vehicle crashworthiness and occupant response. These activities all require realistic overall vehicle collision acceleration time histories. The present research studies frontal collision acceleration pulses and presents analytical techniques to model and scale these to different collision severity. These analytical techniques account for shape, amplitude and duration. Derived acceleration pulses allow the generation and study of velocity and displacement time histories for the collision event.

Paper No.400-O

Effect of Frontal Crash Pulse Variations on Occupant Injuries

Steve Mark
Honda R&D Americas, Inc.
United States

Abstract

Injury criteria were calculated for different frontal crash pulses to determine how the shape of the pulse affects occupant injuries.

Paper No.323-O

An Extendable and Retractable Knee Bolster

J. T. Wang, A. L. Browne
General Motors, United States

Abstract

The concept design of an extendable and retractable (E/R) knee bolster is presented in this paper. It automatically extends in an at-risk situation of frontal impact to prepare the vehicle for crash and retracts when risk subsides.

Written Papers

Technical Session

Vehicle Rollover Stability and Rollover Crash Protection

Paper No.216-W

Influence of Passengers During Coach Rollover

James Anderson, Majid Sadeghi
Cranfield Impact Centre Ltd
United Kingdom

Abstract

An assessment has been made of the percentage of the passenger mass that is coupled to the coach structure during the UN-ECE Regulation 66.

Paper No.368-W

Rollover Crashes - Real World Studies, Tests and Safety Systems

Alexander Berg, Michael Krehl
DEKRA Automobil GmbH
Rolf Behling, Michael Helbig
Autoliv GmbH, Germany

Abstract

Improvements of car safety have focused from frontal to side protection during the 90ies. Rollover tests conducted by DEKRA and other test houses in order of car and sensor manufacturers are shown. Additional information from Autoliv about rollover protection hardware and trigger strategies complete the discourse.

Paper No.419-W

An Investigation of Occupant Injury in Rollover: NASS-CDS Data Analysis of Injury Severity and Source by Vehicle Type and Rollover Attributes

Paul Bedewi, Daniel Godrick, Kennerly Digges,
George Bahouth - FHWA/NHTSA
National Crash Analysis Center,
The George Washington University,
United States

Abstract

This paper investigates the circumstances surrounding rollover and subsequent injury. NASS data has been studied to identify injury magnitudes and sources. The circumstances surrounding each rollover have been examined, including the location, severity, and direction of the roll. Findings have been distributed by vehicle type. Conclusions will be made that assess the role of roof crush and interior contacts.

Written Papers

Technical Session

*Compatibility in Frontal/Side Collisions

Paper No.238-W

Parameter optimization for vehicle-to-vehicle crash compatibility using Finite Element Methods

In Taek Lee, Katsutoshi Ainaka,
Minoru Yubuchi, Junki Saiki
Altair Engineering Ltd
Japan

Abstract

Now, many auto makers and national researchers are interested in the compatibility of standard vehicle crash testing to that of real accident conditions. Current standard tests assume like vehicle-to-vehicle crash events to address the injury or fatality risk to vehicle occupants. Researchers that investigate vehicle-to-vehicle crash tests struggle to understand the relationship between aggressivity and injury.

Paper No.364-W

Estimating relative driver fatality and injury risk according to some characteristics of cars using matched-pair multivariate analysis

Jean-Louis Martin, Yves Derrien,
Bernard Laumon, INRETS, France

Abstract

To focus on the crashworthiness of cars, we examine risk factors of severity for the drivers involved in two-car accidents, using matched-pair logistic regression. Recent cars provide a better protection, but the compatibility of cars according to their weight is shown as a big issue. The necessity of adaptative safety devices for taking the characteristics of a car occupant into account is also confirmed.

Paper No.393-W

NHTSA's Review of High-Resolution Load Cell Walls' Role in Designing for Compatibility

Matthew Jerinsky, William T. Hollowell
National Highway Traffic
Safety Administration, United States

Abstract

As the ratio of light trucks to automobiles increases, vehicle compatibility has come into question in recent years. A number of tests and performance criteria are under development worldwide to quantify a vehicle's structural design in frontal impacts. These tests and criteria record the force exerted by a vehicle structure onto a high-resolution rigid wall to determine the height from ground of the force as well as its gradient across the load cells. This paper presents NHTSA's computer simulation research of these vehicle performance tests as they pertain to vehicle compatibility. A number of frontal impact scenarios of a light truck impacting various load cell walls with and without a deformable face are simulated. Changes are made to the vehicle's structure, and the effects to the evaluation criteria are presented.

Paper No.413-W

Vehicle-to-Vehicle Full Frontal Compatibility Crash Optimization Using a CAE-Based Methodology

Xiaowei Li, Philip Przybylo, Priya Prasad,
Saeed Barbat, Ford Motor Company
United States

Abstract

The objective of the study described in this paper is to conduct design of experiments and optimization analyses for full frontal vehicle-to-vehicle impact utilizing math modeling techniques. The outcome is the development of prediction equations and response surfaces for the vehicle structural performance and crash energy management in terms of vehicle design parameters such as mass, stiffness and geometry.

Paper No.507-W

Vehicle Incompatibility Affects Occupant Extrication after Motor Vehicle Crashes

Frank Pintar, Narayan Yoganandan
Medical College of Wisconsin
John Olshanski
Safe and Fast Extrication, Inc
United States

Abstract

The study determined force directions, vehicle types, and whether struck or striking vehicles were associated with occupant extrication. FARS and CIREN databases were queried. Highest risk occupants are those traveling in a car that has been struck by a truck on the left side. Light weight cars under 2500 pounds are also most often involved in occupant extrication. This study infers that vehicle incompatibility may have a greater effect on the need for occupant extrication than many other factors.

Paper No.518-W

Vehicle Front Structure in Consideration of Compatibility

Shinji Fujii
Mazda Motor Corporation
Japan

Abstract

This paper proposes a vehicle front structure and countermeasure direction, which improve compatibility performance focusing on sub-frame which increases load path routes. Further, more progressive sub-frame with effective energy absorption is introduced.

Written Papers

Technical Session

Real World Data Acquisition, Injury Risk Assessment

Paper No.150-W

Benefit potential of ESP in real accident situations involving cars and trucks

Klaus Langwieder, Johann Gwehenberger,
Thomas Hummel, German Insurance Association;
Institute for Vehicle Safety, Germany

Abstract

The Electronic Stability Program (ESP) for passenger cars stabilises the vehicle in adverse road circumstances and during evasive maneuvers. Combined with roll-over preventing systems, such systems represent for commercial vehicles an accident avoidance potential as well, especially regarding dangerous rollovers and jack-knifing. The following paper presents results of an analysis conducted by the GDV in which the benefit potential of ESP in terms of maximum possible benefit and possible positive influence on car and truck accidents was determined.

Paper No.232-W

Crash Attributes that Influence Aortic Injuries in Near-Side Crashes

Jeffrey Augenstein
William Lehman Injury Research Center
Kennerly Digges, Jessica Steps
National Crash Analysis Center,
The George Washington University
Kazuo Higuchi, Takata Corporation
United States
Tadayuki Ato, Takata Corporation
Japan

Abstract

NASS and William Lehman Injury Research Center data are examined to determine the factors that influence aortic injury in near-side crashes. In addition to qualitative evaluation, regression analysis is used to examine the role of occupant and crash characteristics in predicting aortic injury.

Paper No.252-W

Large Truck Crash Causation Study in the United States

Gary Toth, Gregory Radja, Kristin Thiriez,
Joseph Carra, National Highway Traffic
Safety Administration, United States

Abstract

The U.S. Department of Transportation has been conducting a study on the causes of large truck crashes. A database containing highly detailed data on 1,000 serious truck crashes is being created. This paper will describe the information in the database and the potential uses of the data. It will also discuss the methods being used to describe the contributing factors to each crash.

Paper No.256-W

NHTSA's Tire Pressure Special Study, February 2001

Kristin Thiriez, Nancy Bondy
National Highway Traffic
Safety Administration, United States

Abstract

The National Center of Statistics and Analysis of NHTSA has completed an intensive data collection effort on the state of America's tires. Measurements were taken and interviews were conducted to compile a database of over 11,000 passenger vehicles. This paper will discuss the methodology of the study as well as the extent of underinflation found in the field and the attitudes and maintenance habits of drivers.

Paper No.260-W

Real-world Accident Data Coordinated Methodologies for Data Collection to Improve Vehicle and Road Safety

Pete Thomas, James Lenard,
Andrew Morris, Vehicle Safety
Research Centre, United Kingdom

Abstract

The paper defines the need for a co-ordinated approach to accident and crash injury data gathering. The specific approaches of territories with high levels of integration are identified. Accident monitoring and review systems are an essential component of improving vehicle safety. The paper identifies areas for further action at European level and proposes the need for IHRA activity to harmonise international approaches. Accident investigation needs to be closely aligned with policy and safety strategy.

Paper No.285-W

Change of Velocity And Crash Pulse Characteristics In Rear Impacts: Real World Data and Vehicle Tests

Astrid Linder, Matthew Avery
Thatcham, The Motor Insurance
Repair Research Centre, United Kingdom
Krafft Maria, Anders Kullgren
Folksam, Sweden

Abstract

Crash pulses from vehicle tests and real-world collisions were examined in the range of change of velocities where soft tissue neck injuries are reported. The results show that a similar change of velocity can be generated by various characteristics of the crash pulse in rear impacts for cars impacted in the same configuration and from the same car model in real-world collisions.

Paper No.299-W

Air Bag Crash Investigations

John Kindelberger, Augustus "Chip" Chidester,
Eric Ferguson, National Center for Statistics and
Analysis, National Highway Traffic
Safety Administration, United States

Abstract

Recent methods and findings from the National Highway Traffic Safety Association's Special Crash Investigations program are presented. Topics include air bag related fatalities and injuries, redesigned air bags, and other relevant areas of study.

Paper No.353-W

On The Spot Crash Investigations in the UK: New Insights for Vehicle Safety Research

Richard Cuerden
TRL Limited
Julian Hill
Vehicle Safety Research Centre
United Kingdom

Abstract

A major study of accident causation was initiated in the UK in 2000. The project involves a highly in-depth assessment of crash circumstances by the scene of the crash shortly after the event. The paper presents the first findings of the study that relate to both passive and active safety issues. The first analysis of the data is presented together with representative case studies.

Paper No.403-W

NHTSA's Vehicle Parameter and Crash Test Databases

Catherine McCullough, Barbara Hennessey
National Highway Traffic
Safety Administration, United States

Abstract

This paper will describe the contents, development, and use of the National Highway Traffic Safety Administration's (NHTSA) Vehicle Parameter and Crash Test Databases in crash analysis and injury determination.

Paper No.439-W

Review of Car Frontal Stiffness Equations for Estimating Vehicle Impact Velocities

Tao Jiang, Raphael Grzebieta,
George Rechner, Xiao-Ling Zhao Department of Civil
Engineering, Monash University
Shane Richardson, DV Experts
Australia

Abstract

This paper reviews all equations proposed over three decades for predicting the equivalent barrier impact velocity (ΔV) and car crush distance for a frontal crash. The equations are compared to numerous crash data from NCAP, regulatory testing and laboratory tests. Estimates of error bands are provided.

Paper No.467-W

Methodology for the Development and Validation of Injury Predicting Algorithms

Jeffrey Augenstein, Elana Perdeck,
James Stratton, William Lehman Injury
Research Center
Kennerly Digges, George Bahouth
The George Washington University
Peter Baur, BMW NA, United States
Nils Borchers, BMW AG, Germany

Abstract

The URGENCY Algorithm predicts the likelihood of severe injury based on motor vehicle crash characteristics. Enhancements made to the URGENCY Algorithm and the methodology used to validate recent models using real world crash data are presented. Additionally, the approach used to determine those crash variables that are most important for the prediction of injury during crash events is given.

Paper No.494-W

New Accident Research System of German Insurers and Highlights of the Main Topics

Dieter Anselm, GDV Loss Prevention Commission
Klaus Langwieder, German Insurance Association;
Institute for Vehicle Safety, Germany

Abstract

Within the German Insurance Association engineers and physicians have analysed large scale accident materials with respect to accident circumstances, impact severity, injuries and effectiveness of safety systems. In the year 2000 a new system with direct access to accidents of specific car makes/models was established. This offers the possibility to analyse the real-world experience with recent safety systems. Results from this new research procedure concerning airbags, new seat-/head restraint systems and possible effect of motorcycle antilocking systems are given.

Paper No.500-W

Estimating the Lives Saved by Seat Belts and Air Bags

Donna Glassbrenner, Joseph Carra
National Highway Traffic
Safety Administration
United States

Abstract

We present a non-technical discussion of changes made to the calculations of the lives saved by seat belts and air bags published by the National Highway Traffic Safety Administration (NHTSA).

Written Papers

Technical Session

Advanced Technology #1: Passive Restraint Systems

Paper No.144-W

A Seat Belt Buckle Pretensioner and Load-Limiter Combo Device

J. T. Wang, Qing Zhou
General Motors
United States

Abstract

A combined pretensioning and load-limiting device for seat belt systems is presented in this paper. In this two-in-one design, the webbing displacement induced by the operation of a buckle pretensioner is reused for load-limiting purposes.

Paper No.224-W

Seat component to prevent whiplash injury

Kai-Uwe Schmitt, Marco Heggendorn,
Peter Niederer, Institute of Biomedical Engineering,
University and Swiss Federal Institute of
Technology, Zurich
Markus Muser, Felix Walz, Working Group on Accident
Mechanics, Zurich, Switzerland

Abstract

In order to prevent the relative acceleration of the head and the torso of an occupant sitting in a standard car seat during a rear-end impact, a device was developed which allows a translational motion of the seat relative to the car while damping this motion. This leads to a delay of the building up of the torso loading. Thus the main effect is the synchronization of the loading of the head and the upper torso.

Written Papers

Technical Session

*Biomechanics #2: Injury Criteria and Dummy Development

Paper No.68-W

How injury criteria correlate with the injury risk - a study analysing different parameters with respect to whiplash injury

Markus Muser, Working Group on Accident
Mechanics, Zurich
Kai-Uwe Schmitt, University and Swiss Federal
Institute of Technology, Switzerland
Wolfram Hell, Institute for Vehicle Safety –
GDV, Munich, Germany

Abstract

The correlation of injury criteria and real world accident data was analysed. For different vehicles, the risk of whiplash injury as determined from the data base was compared with results from sled test experiments and different injury criteria derived thereof. Finally, when assessing the risk of neck injuries it is recommended to use such a combination of criteria rather than focusing on a single criterion only.

Paper No.76-W

Biofidelity Impact Response Requirements For An Advanced Mid-Sized Male Crash Test Dummy

Birgitte van Don, Michiel van Ratingen
TNO Automotive, Netherlands
Francois Bermond, Catherine Masson,
Philippe Vezin, France
David Hynd, Claire Owen, TRL
United Kingdom
Luis Martinez, INSIA, Spain
Stephan Knack, BAST, Germany

Abstract

The Hybrid-III is over two decades old, the European Enhanced Vehicle-safety Committee is studying alternatives to the existing dummy. Key is the development of a well defined set of requirements that identifies the minimum level of biofidelity required for a frontal dummy as presented in this paper. Source data reference, short description of the test and the defined corridors are provided.

Paper No.115-W

The Strain-Rate Dependence of Mechanical Properties of Rabbit Knee Ligaments

Sota Yamamoto, Akinori Saito, Kei Nagasaka,
Satoshi Sugimoto, Koji Mizuno, Eiichi Tanaka
Nagoya University
Masaki Kabayama, Matsusita Electric Works, Ltd.
Japan

Abstract

Knee ligaments are frequently injured in car-to-pedestrian collisions. So we conducted tensile tests for rabbit MCL and ACL to evaluate their strain-rate dependence of mechanical properties. The failure stress and strain of MCL increased with strain rate. The avulsion load of MCL tibial insertion was lower than the failure load of MCL among all conditions. For all ACL tensile tests, tibial insertions were failed.

Paper No.417-W

Development of Neck Injury Assessment Criteria for the ISO 13232 Motorcyclist Anthropometric Test Dummy With the Revised Neck

R. Michael Van Auken, John W. Zellner,
Scott A. Kebschull, Kenneth D. Wiley
Dynamic Research, Inc.
Terry A. Smith, Protection Research Laboratory
United States
Nicholas Shewchenko
Biokinetics and Associates Ltd.
Canada
Nicholas M. Rogers, International Motorcycle
Manufacturers Association, Switzerland

Abstract

The development of a four axis neck injury assessment criterion for the revised ISO 13232 dummy neck is described. The distribution of neck injuries in 568 real-world motorcycle crashes were fitted to upper neck forces and moments from calibrated computer simulations. The injury criterion can estimate the probability of neck injury with high level of overall agreement with neck injuries in real world crashes.

Paper No.418-W

An Improved Dummy Neck for the ISO 13232 Motorcyclist Anthropomorphic Test Dummy

Christopher Withnal, Nicholas Shewchenko
Biokinetics and Associates Ltd., Canada

Kenneth D. Wiley, Dynamic Research Inc.

United States

Nicholas M. Rogers, International Motorcycle
Manufacturers Association, Switzerland

Abstract

A new neck has been designed, tested and approved for use with the Motorcyclist Anthropomorphic Test Device described in ISO 13232.

Paper No.483-W

ADVISER: a software tool for evaluation and rating of numerical models in crash safety analyses

Jack van Hoof, TNO Automotive, Netherlands
Kambiz Kayvantash, Mecalog, France

Roberto Puppini, CRF, Italy

Hans Baldauf, BMW, Germany

Charles Oakley, TRL

United Kingdom

Abstract

A software tool called ADVISER was developed to automatically evaluate numerical models used in crash safety assessments. ADVISER includes objective correlation criteria and a method to rate the quality of a model by following a general validation procedure implemented in the software tool. Existing models of crash dummies, humans, vehicles, restraint systems and barriers were evaluated for a range of impact directions and velocities (frontal, side, oblique) using ADVISER.

Written Papers Technical Session

Advanced Technology #2: Driver-Vehicle Safety/Driver Performance

Paper No.179-W

Overhead Capacitive Sensing System For Driver Alertness Self-Monitoring

Philip Kithil, Advanced Safety
Concepts, Inc., United States

Abstract

An overhead capacitive sensing system for monitoring driver alertness has been developed which allows the driver to engage with the system in a self-monitoring feedback loop.

Paper No.340-W

A Study on driver behavior during braking on open road

Mohamed Kassaagi, Guillaume Brissart
Laboratory of Accidentology, Biomechanics
and human behaviour PSA Peugeot
Citroen - RENAULT
Jean-Christophe Popieul
Laboratory of Industrial and Human
Automation, Mechanics and Computer
France

Abstract

Active safety devices are often based on drivers' behavior. Their efficiency depends on the representativeness of the experimental data used for their tuning, and on the determination of the triggering criteria. So an experiment was performed on open road in order to study the braking actions of about a hundred of volunteers, driving around 100 km in the Paris area. 23000 braking actions were analyzed.

Paper No.456-W

Measuring and Modeling of Driver for Detecting Unusual Behavior for Driving Assistance

Yasuo Sakaguchi, Ken'ichiro Takiguchi
Research Institute of Human Engineering
for Quality Life
Masayuki Okuwa
Toyota Central R&D Labs., Inc.
Motoyuki Akamatsu
National Institute of Advanced Industrial
Science and Technology
Japan

Abstract

We developed test vehicles with an on-board driving recorder and several sensors to measure usual driving behavior. In order to develop new driving support method, we also modeled the driving behavior which is measured the vehicle using Bayesian Network which is a graphical model obtained from statistical behavior data and Hidden Markov Model.

Paper No.506-W

A Study on the Onset Timing of Collision Avoidance Assistance System for Minimizing the Over-reliance on the System

Keisuke Suzuki
Japan Automobile Research Institute
Japan

Abstract

We analyzed the relation between the onset timing of Forward Collision Avoidance Assistance System (FCAAS) and the level of over-reliance on the system. In a condition when the system was activated at the timing when Time to Collision is less than 1.7s, no driver showed the over reliance on the system. We think this timing is one of the optimal timing for the onset of FCAAS, in view of minimizing the over-reliance on the system.

Paper No.541-W

Analysis of VSC's effectiveness from accident data

Masami Aga
Toyota Motor Corporation

Japan

Abstract

In order to determine exactly what kind of technologies should be developed for cars to reduce accidents, it is necessary to conduct a detailed analysis of driver's and vehicle's behavior before crashes.

Paper No.542-W

An Estimation Method for Emergency Handling

Performance

Kenichi Kitahama, Masami Aga
Toyota Motor Corporation
Japan

Abstract

Recently in active safety field, chassis control systems such as ABS, VSC(Vehicle Stability Control) are widely spread to vehicles. However they are founded on vehicle's basic emergency handling performance represented as "turn" or "stop" that should also be improved.

Written Papers

Technical Session

*Improved Safety for Vulnerable Road Users

Paper No.58-W

Crash Simulations of a 3 wheeled scooter taxi (TST)

Anoop Chawla, Dinesh Mohan,
Sudipto Mukherjee, Jasvinder Singh,
Nadeem Rizvi
Indian Institute of technology, Delhi
India

Abstract

A rigid body model of the TST using MADYMO to simulate impact between a TST and the pedestrian are described along with a frontal impact of the TST with a rigid barrier. Low cost modifications to the base model of the TST lower the injury measures for the pedestrians and occupants. The paper describes the development of rigid body simulations for area specific vehicles and their crashworthiness and evolves solutions to minimize injuries.

Paper No.79-W

Simulation of 2-wheeled Rider to Car Accident scenarios, using an adapted LS-DYNA pedestrian humanoid

William McLundie
Cranfield University, United Kingdom

Abstract

To provide a foundation for understanding 2-wheeled accidents in greater detail, an LS-DYNA pedestrian humanoid model is being adapted to examine 2-wheeled rider to car crash scenarios. The paper will describe the systematic approach to construction and correlation of the total system, and areas of interest that are worthy of further investigation.

Paper No. 207-W

Human Body Detection Technology by Thermoelectric Infrared Image Sensor

Masaki Hirota, Yasushi Nakajima,
Masanori Saito, Makoto Uchiyama
Nissan Motor, Japan

Abstract

This paper describes a newly developed thermoelectric infrared imager having a 48 x 32 element thermoelectric focal plane array (FPA) and an experimental vehicle featuring a blind spot pedestrian warning system, which employs four infrared imagers.

Paper No. 237-W

Computational Simulation for Head Impact on Vehicle Hoods Using the Precise Finite Element Model

Nobuhiro Iwai
Nissan Motor Co., Ltd., Japan

Abstract

This paper will describe actual head impact studies on hoods of vehicles using head dummy and engine compartment finite element models. Head Injury Criteria (HIC) is used in this prediction method by post-processing the acceleration history. Close agreement between the test and the calculated values of the acceleration history is obtained.

Paper No.247-W

Recent Trends In Fatal Motorcycle Crashes

Umesh Shankar, US Department of
Transportation, National Highway
Traffic Safety Administration, NPO-121

Abstract

Motorcyclist fatalities have increased four years in a row after reaching a historic low of 2,116 fatalities in 1997. In 2001 3,181 motorcyclists were killed an increase of 1,065 fatalities or over 50% increase between 1997 and 2001. Without these substantial increases in motorcyclist fatalities overall highway fatalities in the United States would have experienced marked reduction of about 2.5 percent.

Paper No.271 -W

Evaluation of pedestrian protection structure using impactors and full-scale dummy test

Toshihiro Ishikawa
Mazda Motor Corporation
Japan

Abstract

Three sub-system tests have been proposed by EEVC/WG17 to evaluate car front aggressiveness against pedestrian. On the other hand, a pedestrian full-scale dummy has been developed. The object of this study is to clarify the differences between the sub-system tests and the full scale dummy tests

Paper No. 294-W

Development of Plastic Components for Pedestrian Head Injury Risk Reduction

Brian Boggess, Jenny Wong,
Steve Mark, Honda R&D Americas, Inc.
United States

Abstract

Investigations through testing and simulation showed that different cowl top designs significantly affect the risk of pedestrian head injury. This research demonstrates that plastic components can contribute significant stiffness in pedestrian impacts. CAE analyses were performed to support design changes and ultimately reduce the risk of head injury to pedestrians.

Paper No.335-W

Development of LS-DYNA FE Models for Simulating EEVC Pedestrian Impact

Mark Neal, Heui-Su Kim,
Jenne-Tai Wang, General Motors
Takanobu Fujimura, Katsumi Nagai
Suzuki motor Corporation
Japan

Abstract

The paper will describe the procedure of developing finite element models of the European Enhanced Vehicle Safety pedestrian impactors.

Paper No.443-W

Development of ISO Pedestrian Child and Adult Head-Form Impactors

Yasuhiro Matsui, Akira Sasaki,
Adam Wittek, Masaru Takabayashi,
Hiroyuki Jimbo, Japan Automobile
Research Institute
Kimiaki Nimura, ESTECH CO., Ltd.
Yoshihiro Ozawa, JASTI CO., Ltd.
Japan

Abstract

JARI developed new child and adult head-form impactors according to the requirements of ISO subsystem test procedures. This paper presents the results of biofidelity certification tests and analysis of the durability and robustness of the skin of these newly developed impactors. Then, the technical specifications, such as location of center of gravity and first natural frequency of the impactors, are summarized.

Paper No.466-W

The danger to young pedestrians from reversing motor vehicles

Michael Paine, Vehicle Design and Research
Adam Macbeth, Insurance
Australia Group
Michael Henderson
Michael Henderson Research
Australia

Abstract

We examine vehicle-related countermeasures to reduce the risk of young children being run over by reversing vehicles. Most popular vehicles have a poor view to the rear. Proximity sensors and visual aids are possible ways to assist the driver.

Paper No.499-W

A review and development of the IHRA pedestrian model

Mike Neale, Brian Hardy,
Graham Lawrence
TRL Limited, United Kingdom

Abstract

The IHRA Pedestrian Working Group is using a pedestrian model to develop a test method for assessing head impact behaviour in vehicle-pedestrian accidents. To address concerns regarding the predictive accuracy of the chosen pedestrian model, TRL Limited has undertaken a study to review and develop the model. This paper details improvements made to the model's structure to enhance its predictive accuracy, resulting in an improved pedestrian model for developing the IHRA pedestrian head impact test.

Paper No.140-W

A Review of Pediatric Pedestrian Injuries at a Level I Trauma Center

William Woods, Christopher Sherwood,
Johan Ivarsson
University of Virginia, United States

Abstract

This paper presents a review of over 4000 injuries to pediatric pedestrians (0 to 18) admitted to a Level I Trauma Center.

An advanced testing procedure for the pedestrian-car-collision

Matthias Kuehn, Robert Froeming,
Volker Schindler
Technical University of Berlin
Germany

Abstract

The presented approach for a test procedure combines numerical simulations and component tests into a Hybrid-Test. It is able to solve most of the mentioned disadvantages of a conventional component test without complicating it unduly.

Paper No.272-W

Written Papers

Technical Session

*Advanced Intelligent Technologies - ITS

Paper No.582-W

Development of ASV in Japan

Katsutoshi Ishida, Shinichi Yamada, Road Transport Bureau,
Ministry of Land, Infrastructure and Transport, Japan
International Affairs Office, Safety and Engineering
Department, Japan

Abstract

Japan has been promoting the development and spread of Advanced Safety Vehicles (ASVs), which feature a high level of intelligence and remarkably improved safety thanks to electronic and other new technologies that have been rapidly developing in recent years. The ASV Promotion Project, Third Phase, has been in place since 2001 for the further development and spread of ASV technologies.

Paper No.109-W

Onboard Road Obstacles Detection in Night Condition Using Binocular CCD Cameras

Raphaël Labayrade, Didier Aubert,
Sio Song Leng
Laboratory on the Interactions between
Infrastructure, Vehicle and Driver
(LIVIC - INRETS/LCPC)
France

Abstract

This paper presents a CCD based stereovision algorithm for onboard road obstacles detection (pedestrians, vehicles, motorbike, etc.) in night condition. The algorithm is explained, and then evaluated towards different obstacles. Experiments show that obstacles are detected in a precise manner with high confidence values, at frame rate (25 Hz) using no special hardware.

Paper No.166-W

Accuracy in the obstacle localisation using vision

Glaser Sebastien, Rudy Alix
Laboratoire Central des Ponts et
Metropolitain Chaussées
France

Abstract

The localisation computed by vision needs to be analysed in term of precision. This paper attempts to explore differences in localisation accuracy between systems involving only one camera (monocular vision) and systems involving two cameras (stereovision). A complete study of the errors committed on depth reconstruction is shown.

Paper No.459-W

Merging lateral cameras information with proprioceptive sensors in vehicle location gives centimetric precision

Sio-Song Leng, Dominique Gruyer
Institut National de recherche sur les
transports et leur sécurité

Abstract

This paper proposes a new algorithm merging information given by proprioceptive sensors and lateral cameras to locate vehicle on the road with centimetric precision. The goal of this system is to improve road safety by providing vehicle's distance to the lane marking and its course to a driver assistance or automatic positioning system.

Paper No.543-W

Development of Night View System

Yoichi Iwata, Kunihiro Toyofuki,
Yasuo Hagisato
Toyota Motor Corporation
Japan

Abstract

We have developed a night vision system called Night View to assist driver view at night driving. This system can capture the image beyond the range of low beam with the near-infrared camera and display monochrome virtual image onto the windshield in front of the driver.

Paper No.544-W

Development of Pre-Crash Safety System

Koichi Fujita, Takaaki Enomoto,
Ryotaro Kachu, Hideki Kato,
Hiroaki Fuinami, Kiyotaka Moriizumi
Vehicle Engineering Division Vehicle
Safety, Japan

Abstract

For traffic safety, a lot of means concerning active safety and passive safety was studied, as a result, a lot of safety device was developed. And now each device has been complicated. In future it will be important that the safety performance will be secured reasonably by relating to active safety and passive safety effectively.

Paper No.545-W

Pre-Crash Sensor For Pre-Crash Safety

Setsuo Tokoro, Kaushi Kuroda,
Tomoki Nagao, Tomoya Kawasaki
Electronics Engineering, Japan

Abstract

One of the purposes to develop ITS(Intelligent Transportation System) technology is to enhance driving safety. Using ITS technology, we have developed "Pre-crash Safety" system.

Written Papers

Technical Session

Child Restraint Systems

Paper No.121-W

An Investigation of Side Impact Testing Methodologies for Child Restraint Systems using Finite Element Simulations

Jesus Monclus -Gonzalez
Royal Automobile Club of Spain, Spain
Dhafer Marzougui, George Bahouth,
Azim Eskandarian
FHWA/NHTSA National Crash
Analysis Center, United States

Abstract

This paper describes an array of Finite Element simulations of a forward facing convertible child safety seat in frontal and side impact scenarios (ISO proposal). The influence of several parameters in the injury criteria measured on the Hybrid III 3 year old dummy model, as well as door intrusion patterns and profiles during Finite Element reconstructions of two case studies are discussed.

Paper No.122-W

Spanish CRS Use and Effectiveness Survey Results

Jesus Monclus -Gonzalez
Royal Automobile Club of Spain, Spain

Abstract

The current situation of Child Restraint System (CRS) use and effectiveness in Spain outside built-up areas is described by means of 800 questionnaires collected by the National Traffic Police in a period of 6 months. Information gathered in the questionnaires included: crash, vehicle and road type, principal direction of force, seating position, injury outcome, injury source, other occupants' morbidity and CRS use.

Written Papers

Technical Session

Developments in Frontal Impact Protection

Paper No.520-W

Study on Fuel Leakage Measurement System for Fuel Cell Vehicles

Hiroyuki Mitsuishi, Yohsuke Tamura,
Jinji Suzuki, Koichi Oshino, Shogo Watanabe
Japan Automobile Research Institute
Japan

Abstract

We have been examined the safety evaluation methods of fuel leakage at the normal usage condition and the collision condition, so that FCV use the compressed hydrogen gas as the fuel source. We have done the crash test using the moving barrier as simulated FCV to examine the fuel leakage measuring method, as one of the safety evaluation methods of FCV.

Paper No.327-W

A study for fast analysis method of vehicle body structure for offset crash

Hirofumi Deguchi, Naoyuki Suzuki,
Ryoji Nakahama
Mitsubishi Motors Corporation, Japan

Abstract

A fast analysis method of vehicle body structure for offset crash test was investigated from the various parameters such as section properties, vehicle mass and crushable length in the engine compartment. Some practically useful relationship between these parameters and the vehicle crashworthiness was found out.

Paper No.264-W

A Fundamental Study of Frontal Oblique Offset Impacts

Hidetsugu Saeki, Tetsuo Maki,
Hiroyuki Miyasaka, Maki Ueda
Nissan Motor Co., Ltd., Japan

Abstract

In the real world, many of frontal collisions are oblique offset impacts. Such impacts may differ from head-on collisions in terms of vehicle body deformation and occupant behavior. In this work, vehicle and occupant behavior were analyzed in oblique offset impacts, involving vehicle-to-vehicle crashes of ordinary medium-size passenger cars, and in FEM simulations. A fundamental study was then made of the results.